

STUDIES OF NEOTROPICAL COMPOSITAE-IV.  
***PSEUDOGNAPHALIUM LEUCOSTEGIUM*, A NEW SPECIES FROM HUEHUETENANGO,  
GUATEMALA, AND A NEW COMBINATION IN *CHIONOLAENA* (GNAPHALIEAE)**

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ABSTRACT

A new species, *Pseudognaphalium leucostegium* Pruski, is described from Huehuetenango, Guatemala. The combination *Chionolaena stolonata* (S.F. Blake) Pruski, based on *Gnaphalium stolonatum*, is made.

**KEY WORDS:** Asteraceae, Central America, *Chionolaena*, Compositae, Cuchumatanes, Gnaphalieae, *Gnaphalothamnus*, *Gnaphalium*, Guatemala, Huehuetenango, Mesoamerica, *Pseudognaphalium*.

The following taxonomic innovations in Compositae tribe Gnaphalieae are validated preliminary to the treatment of Compositae for Flora Mesoamericana. Both species treated here are white-bracted and endemic to Huehuetenango, Guatemala. Each species would fall under the umbrella of a traditionally defined *Gnaphalium* L. but differs by technical features as discussed below.

**PSEUDOGNAPHALIUM LEUCOSTEGIUM** Pruski, sp. nov. **TYPE:** GUATEMALA. Huehuetenango: ravine near the ruins of Zacaleu, mixed forest area near Huehuetenango, 1800 m, 5 Dec 1962, *Williams et al.* 22433 (holotype: NY). Figure 1.

Plantae herbaceae perennes 0.3+ m altae; folia linearia 1-3 cm longa 0.1-0.2 cm lata subtus sericea-tomentosa revoluta; capitulescentia paniculata-glomerulata, capitula 4-5 mm alta 2.5-4 mm lata, involucrem hemisphaericum vel campanulatum, phyllaria ca. 31 4-6-seriata alba, externa triangulari-ovata 1.8-2.5 mm longa 1.5-2.2 mm lata obtusa, interna oblanceolata vel oblonga 4-5 mm longa 0.5-1 mm lata obtusa vel rotundata, flosculi pistillati 18-23, flosculi disci 23-25, corollis 2.5-3 mm longis, styli rami truncati, cypselae ca. 0.5 mm longae, setae pappo ca. 3 mm longae.

**Perennial herbs** 0.3+ m tall; stems erect or ascending, several-branched distally, moderately to densely leafy, exalate, closely sericeous-tomentose, eglandular, internodes much shorter than leaves. **Leaves** sessile, linear, 1-3 cm long, 0.1-0.2 cm wide, the more distal ones strongly ascending, midrib impressed adaxially, surfaces slightly bicolorous, adaxial surface green to gray-green, eglandular and arachnoid-lanate, abaxial surface grayish, closely sericeous-tomentose, base very slightly dilated and scarcely subclasping, short-decurrent for 1-3 mm onto stem, margins entire, revolute, apex short-apiculate. **Capitulescence** of ca. 9 branches each terminated by a narrowly paniculate-glomerule, branches 10-20 cm long, glomerules 1-1.7 cm diam., held slightly above the evenly desiccant stem leaves, broadly rounded, each 5-13-capitulate. **Capitula** (immature) 4-5 mm tall, 2.5-4 mm wide, 41-48-flowered; involucre hemispherical or broadly campanulate; phyllaries ca. 31, imbricate, graduate, 4-6-seriate, outer phyllaries about ½ as long as the inner, appressed, glabrous, sterome divided, 0.5-1.5 mm long, pale greenish, lamina of each white and strongly opaque; outer phyllaries broadly triangular-ovate, 1.8-2.5 mm long, 1.5-2.2 mm wide, apex broadly obtuse, evenly grading to mid-series and inner series; mid-series phyllaries and inner phyllaries oblanceolate to oblong, 4-5 mm long, 0.5-1 mm wide, apex broadly obtuse to rounded;





Figure 1. Holotype of *Pseudognaphalium leucostegium* Pruski (*Williams et al.* 22433, NY).

receptacle ca. 1 mm diam. **Marginal florets** pistillate, 18–23, less numerous than the disk florets. **Disk florets** bisexual, 23–25; corolla (immature) 2.5–3 mm long, lobes sparsely papillose; immature styles branched within anther cylinder, branches truncate, papillose only apically. **Cypselae** (immature) and ovaries ca. 0.5 mm long, glabrous; pappus bristles ca. 3 mm long, individually deciduous, evenly thickened throughout, never clavate, terminal cells obtuse.

Distribution and ecology: *Pseudognaphalium leucostegium* was collected at about 1800 meters elevation near the Mayan ruins of Zacaleu, just outside the modern-day city of



Huehuetenango, Guatemala. *Pseudognaphalium leucostegium* appears to be endemic to the environs of Huehuetenango and is known to be in early flower in December.

*Pseudognaphalium* Kirp. is a segregate of *Gnaphalium* and is characterized by phyllary bases with divided (fenestrate) stereomes (Hilliard & Burt 1981; Anderberg 1991). *Pseudognaphalium leucostegium* has fenestrated phyllary bases and is thus described in *Pseudognaphalium*. In Flora Mesoamericana I recognize 19 species of *Pseudognaphalium*, with *Gnaphalium polycaulon* Pers. being the sole species retained in *Gnaphalium* s. str. *Pseudognaphalium leucostegium*, the epithet of which alludes to the white lamina of the phyllaries, is part of a species group (including undescribed Mexican species) that is anomalous in *Pseudognaphalium* (Guy Nesom, pers. comm.) by having fewer pistillate florets than bisexual disk florets. In this sexual ratio feature, *P. leucostegium* resembles *Helichrysium* Mill. (Guy Nesom pers. comm.), a genus as traditionally defined is known only from the Old World.

By its narrow leaves and white-opaque phyllaries, *Pseudognaphalium leucostegium* among Mexican and Central American species is most similar to *P. leucocephalum* (A. Gray) Anderb. of northern Mexico and the southwestern United States. Indeed, specimens of *P. leucostegium*, originally distributed as *Gnaphalium stramineum* Kunth, were referred by Nash (1976: 172) to *G. leucocephalum* A. Gray. *Pseudognaphalium leucostegium* differs from *P. leucocephalum* (as well as from *P. stramineum* (Kunth) Anderb., which has phyllary lamina yellowish-tan to stramineous), however, by eglandular vestiture and in the pistillate to bisexual floret ratios, where the marginal pistillate florets of the new species are fewer than the bisexual disk florets. *Pseudognaphalium leucostegium* is by its white-opaque phyllaries also similar to Mexican *P. chartaceum* (Greenm.) Anderb., which differs by having broader, subclasping to clasping, glandular leaves. Occasionally, however, *P. chartaceum* has as many bisexual disk florets as marginal pistillate florets, thus approximating the sexual ratio condition found in *P. leucostegium*.

*Pseudognaphalium leucostegium* by white-opaque phyllaries superficially resembles *Anaphalis margaritacea* (L.) Benth. & Hook. f., which one may possibly expect to encounter planted in tropical gardens or escaping near ruins such as those from where *P. leucostegium* is described. *Anaphalis margaritacea*, however, differs by apically and abaxially (vs. solely apically) papillose style branches and pubescent (vs. glabrous) cypselae and is not known to me to occur in Mesoamerica, cultivated or otherwise.

A second white-bracted gnaphalioid species is treated below. *Chionolaena* DC. was monographed by Freire (1993) who recognized 17 typically subshrubby species. Subsequently, Nesom (2001) transferred to *Chionolaena* an additional five species, these mostly from *Gnaphaliothamnus* Kirp., which he reduced to synonymy of *Chionolaena*.

By the technical floral features of white-opaque spreading inner phyllaries coupled with capitula often with functionally staminate disk florets with purplish and papillose corolla lobes, *Gnaphalium stolonatum* S.F. Blake fits comfortably within *Chionolaena* as circumscribed by Freire (1993) and as emended by Nesom (2001). The new combination *C. stolonata* is thus proposed. Within *Chionolaena*, however, *C. stolonata* is apparently unique by occasionally producing stolons in immature plants. Among species from southern Mexico and Guatemala, *C. stolonata* appears by leaf shape most similar to *C. elegnoides* Klatt, *C. lavandulifolia* (Kunth) Benth. & Hook. f. ex B.D. Jacks., *C. mexicana* S.E. Freire, and *C. salicifolia* (Bertol.) G.L. Nesom. *Gnaphalium stolonatum* differs from these species by the combination of smaller leaves that are often remote distally and its stalked capulescence. Because *C. stolonata* slightly differs vegetatively from typical *Chionolaena*, I have provided a description and a photograph of it to aid in identifications.



**CHIONOLAENA STOLONATA** (Blake) Pruski, comb. nov. *Gnaphalium stolonatum* S.F. Blake, Brittonia 2: 341. 1937. **TYPE: GUATEMALA: Huehuetenango:** llanos of the Sierra Cuchumatanes, along trail between Huehuetenango and Soloma, 3200 m, 24 Aug 1934, *Skutch 1098* (holotype: GH, photograph in MO; isotype: LL). Figure 2.

**Perennial herbs or reduced subshrubs** 0.1–0.3 m tall, when immature sometimes stoloniferous; stems ascending, often few-branched from subwoody base, 1-few leafy stolons 4–6.5 cm sometimes present, upright branchlets simple below capitulescence, a somewhat densely leafy basal rosette usually also present but sometimes withered in older plants, upright stems often remotely leaved distally (leaves usually moderately ascending) or older plants with stems densely leafy proximally, exalate, arachnoid-lanate, eglandular, the surface often purplish and sometimes visible through indumentum, internodes about as long as leaves. **Leaves** sessile, oblanceolate to spatulate, 1–4.2 cm long, 0.2–0.4 cm wide, surfaces somewhat bicolorous, eglandular, adaxial surface green or gray-green, weakly arachnoid-lanose, abaxial surface griseous arachnoid-lanose, base not dilated, not obviously subclasping, usually about as broad as stem, margins not obviously decurrent onto stems, entire, narrowly revolute, apex obtuse, apiculate. **Capitulescence** narrowly corymbiform-paniculate with a single terminal stalked glomerule, glomerule 1–2 cm diam., rounded, 7–11(–20)-capitulate.



Figure 2. Topotype of *Chionolaena stolonata* (S.F. Blake) Pruski (*Molina 16441*, NY).



**Capitula** 5–7 mm tall, 50–100-flowered; involucre campanulate, base embedded in tomentum; phyllaries 5–7 mm long, to ca. 2 mm wide, slightly graduated with the outer ones about  $\frac{1}{2}$  as long as the inner ones, 4–6-seriate, glabrous or sterome sometimes loosely arachnoid-pubescent, sterome undivided, apex obtuse; outer phyllaries greenish-brown; inner ca. 3 series of phyllaries with lamina white and obviously opaque to near base; receptacle 1–1.5 mm diam. **Marginal florets** pistillate, 30–70+, about as few as the disks to more commonly many more than disks. **Disk florets** often functionally staminate, 11–25; corolla 2.5–3 mm long, cells beaded (with irregular thickenings) longitudinally, lobes purplish and papillose; anther collar elongate and usually slightly longer than the tails; ovary sterile, cylindrical, style branches minutely papillose abaxially. **Cypselae** 0.8–1 mm long, constricted at both ends, oblong-setose with elongate duplex trichomes; pappus bristles ca. 20+, to ca. 3.2 mm long, scabridulous but base and apex more or less smooth, persistent, connate basally and deciduous as a ring, apical cells obtuse to rounded.

**Distribution and ecology:** *Chionolaena stolonata* occurs in alpine areas from 3100–4000 meters elevation. This species is endemic to the Sierra Cuchumatanes in Huehuetenango, Guatemala (Nash, 1976), and is not known to me to occur at similar elevations on any of the relatively nearby volcanoes. *Chionolaena stolonata* has been collected in flower in January, March, and August.

Figure 2. Topotype of *Chionolaena stolonata* (S.F. Blake) Pruski (Molina 16441, NY).

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STUDIES OF NEOTROPICAL COMPOSITAE-V.  
*MUNNOZIA ORTIZIAE* (LIABAEAE), A NEW SPECIES FROM  
THE ANDES OF PASCO, PERU

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ABSTRACT

A new species, *Munnozia ortiziae* Pruski (Compositae: Liabaeae: Munnoziinae), is described from the Andes of Pasco, Peru. It is most similar to *M. oxyphylla*, also of Peru, in its pinnately veined, lanceolate to elliptic-lanceolate leaves and moderately large capitula in loose, open cymose capitulescences.

**KEY WORDS:** Andes, Asteraceae, Compositae, Liabaeae, *Liabum*, *Munnozia*, Munnoziinae, Pasco, Peru.

*Munnozia* Ruiz & Pav. (Compositae: Liabaeae: Munnoziinae) is an Andean-centered genus of more than 40 species (Robinson 1978, 1983). It was resurrected from synonymy of *Liabum* Adans. by Robinson and Brettell (1974) and differs from *Liabum* by black (vs. pale) anther thecae. A new species, *Munnozia ortiziae* Pruski, from the Andes of Pasco, Peru, is described herein. The new species appears most similar to *M. oxyphylla* (Cuatrec.) H. Rob., which is known from Huánuco and Pasco, Peru.

**MUNNOZIA ORTIZIAE** Pruski, sp. nov. **TYPE:** PERU. Pasco. Prov. Oxapampa. Dist. Oxapampa: La Suiza Nueva, open forest with many tree ferns, 10°38' S, 75°27' W, 2240 m, 21 Jun 2003, H. van der Werff, R. Vásquez, B. Gray, R. Rojas, R. Ortiz, & N. Davila 17600 (holotype: MO; isotypes: AMAZ, F, HOXA, USM). Figures 1-5.

Plantae herbaceae perennes vel fruticosae usque ca. 2(-4) m altae, folia opposita petiolata, lamina lanceolata vel elliptico-lanceolata 5-11 cm longa 1-4(-6) cm lata chartacea pinnatim venosa supra virida saepe glabra subtus albo-grisea tomentoso-sericea; capitulescentia cymosa, pedunculi 4-12 cm longi, capitula radiata, involucrem campanulatum vel hemisphaericum, phyllaria subaequalia vel obgradata ca. 3-seriata 9-14 mm longa albo-grisea tomentoso-sericea, flosculi radii 24-36, corollis 24-27.5 mm longis, flosculi disci 40-50+, corollis 7-8 mm longis infundibuliformis, anthera niger, cypselae ca. 1 mm longae strigillose, setae pappo ca. 6 mm longae.

**Perennial herbs to shrubs** to ca. 2(-4) m tall, branching opposite (trichotomous). **Stems** ascending to scandent, subterete or angled, loosely arachnoid-tomentose to sometimes subglabrous proximally. **Leaves** simple, opposite, petiolate; petiole 1-1.5 cm long, narrow, unwinged, slightly dilated and subconnate at base; blade lanceolate to elliptic-lanceolate, 5-11 cm long, 1-4(-6) cm wide, chartaceous, venation pinnate, secondary veins 7-10 per side, surfaces discolorous, adaxial surface green, glabrous or sometimes lingering arachnoid-tomentose, abaxial surface white-gray, tomentose-sericeous, trichomes fused, midrib and secondary veins visible but tertiary reticulation obscured by tomentum, base acute to broadly obtuse, margins entire to less commonly few crenulate-serrulate, apex acute to acuminate. **Capitulescence** few- to several-capitulate, open, cymose; peduncles 4-12 cm long, tomentose-sericeous or lingering arachnoid-tomentose. **Capitula** radiate, many-flowered; involucre campanulate to hemispherical; phyllaries subequal or obgradate, ca. 3-





Figure 1. *Munnozia ortiziae* Pruski. Photograph of a paratype (van der Werff et al. 23417, MO) showing the opposite discolorous leaves and subequal to obgrade tomentose-sericeous phyllaries.

seriate, lanceolate to elliptic-lanceolate, 9–14 mm long, white-gray, tomentose-sericeous with fused persistent (sometimes thinning but never subglabrate) trichomes or inner phyllaries sometimes arachnoid-tomentose; receptacle subpaleate, pseudopaleae ca. 2 mm long, lacerate-echinate. Ray florets 24–36, pistillate; corolla 24–27.5 mm, pale yellow, tube 3–3.5 mm long, limb lanceolate, 21–24 mm long, ca. 2 mm wide, 4-nerved; style well-exserted, subglabrous, branches ascending, linear, ca. 1.5 mm long, terete, stigmatic surfaces continuous. Disk florets bisexual, 40–50+; corolla funnelform, 7–8 mm long, 5-lobed, pale yellow, tube 3–3.5 mm long, narrow, usually shorter than limb, sparsely setose, limb 4–4.5 mm long, throat only slightly ampliate, 1–1.5 mm long, lobes lanceolate, ca. 3 mm long, noticeably longer than short throat, sparsely setulose with antrorse biseriate trichomes apically; anther thecae black, appendage triangular, stramineous; style shaft setulose distally, branches spreading, shortly elliptical, ca. 0.5 mm long, somewhat flattened, abaxially sparsely setulose, stigmatic surfaces continuous. Cypselae obconic, ca. 1 mm long, brown, strigillose; pappus bristles many, subequal, 2–3-seriate, ca. 6 mm long, pale brown, subentire or proximally scabridulous, reaching only to about midpoint of corolla lobes.

**Paratypes.** PERU. Pasco. Prov. Oxapampa. Dist. Chontabamba: Carretera Chontabamba a la Suiza, 2100 m, 11 Nov 2004, *Monteagudo et al.* 7599 (HOXA, MO, USM + 2 unmounted duplicates for distribution); Sector La Suiza, 2211 m, 6 Dec 2004, *Monteagudo et al.* 7876 (AMAZ, HOXA, MO, USM + 2 unmounted duplicates for distribution); La Suiza Nueva, 2240 m, 21 Jun 2003, *van der Werff et al.* 17589 (HOXA, MO, USM + 2 unmounted duplicates for distribution); La Suiza Nueva, 2210 m, 6 May 2005, *van der Werff et al.* 19775 (HOXA, MO, USM + 2 unmounted duplicates for distribution); La Suiza Nueva, 2200 m, 17 Oct 2005, *Vilca & Rojas* 492 (AMAZ, HOXA, MO, MOL, USM + 2 unmounted duplicates for distribution). Dist. Huancabamba: Parque Nacional Yanachaga Chemillén, Grapanazú, alrededor de la laguna San Daniel, 2366 m, 6 Sep 2006, *Castillo* 346 (AMAZ, HOXA, MO, MOL, USM + 2 unmounted duplicates for distribution); Entre el Río cueva blanca y milpo, 2720 m, 18 Sep 2004, *Monteagudo et al.* 7078 (HOXA, MO, USM); Sector Milpa, 3000 m, 1 Feb 2005, *Monteagudo & Francis* 8040 (HOXA, MO, USM); Parque Nacional Yanachaga-Chemillén, cerca a la cordillera Yanachaga, 3330 m, 24 Apr 2007, *Monteagudo et al.* 13801 (HOXA); Lanturachi, sector Santa Barbara, camino a Cueva Blanca, Remanente, 2813 m, 18 Oct 2004, *Perea et al.* 789 (HOXA, MO, USM); Sector Grapanazú, 2400 m, 17 Oct 2003, *Rojas et al.* 1929 (HOXA, MO, USM + 1 unmounted duplicate for distribution), same date and locality, *Rojas et al.* 1977 (HOXA, MO, USM + 1 unmounted duplicate for distribution); Sector Oso Playa, Bosque montano (bofidal) sobre suelo arenoso, 2559 m, 13 Oct 2009, *Valenzuela et al.* 13458 (MO + 2 unmounted duplicates for distribution). Dist. Oxapampa: Parque Nacional Yanachaga Chemillén, Cercanías del Refugio el Cedro, 2240 m, 27 Nov 2002, *Monteagudo et al.* 4456 (HOXA, MO, USM); Parque Nacional Yanachaga Chemillén, Cercanías del Refugio el Cedro, 2200–2400 m, 6 Feb 2003, *Monteagudo et al.* 4491 (HOXA, MO, USM); La Suiza, 2200 m, 10 Dec 2002, *Vásquez et al.* 27750 (HOXA, MO, USM + 2 unmounted duplicates for distribution); Parque Nacional Yanachaga-Chemillén, Sector San Alberto, 2600 m, 14 Mar 2003, *Vásquez et al.* 28023 (HOXA, MO, USM); La Suiza Nueva, 2200 m, 1 May 2003, *Vásquez et al.* 28080 (MO); Parque Nacional Yanachaga-Chemillén, sector Chacos, 2219 m, 21 Jan 2004, *Vásquez et al.* 28834 (HOXA, MO, USM). Dist. not given on labels: Palmazu, Cooperativo Navarra, 2000 m, 5 Mar 1986, *van der Werff et al.* 8373 (MO); Laguna San Daniel, 2400 m, 8 Nov 2009, *van der Werff et al.* 23416 (MO + 1 unmounted duplicate for distribution); Laguna San Daniel, 2400 m, 8 Nov 2009, *van der Werff et al.* 23417 (MO).

**Etymology.** This beautiful new species is named for Dra. Rosa Ortiz (MO), co-collector of the type and a native Peruvian. Rosa Ortiz is a specialist in the taxonomy and phylogeny of Menispermaceae, so it is both appropriate and a pleasure to dedicate to her this new (ascending to) scandent species.





Figure 2. *Munnozia ortiziae* Pruski. Distal portion of stem showing the discolorous leaves and the subequal to obgradeate, tomentose-sericeous phyllaries (Castillo 346)



Figure 3 *Munnozia ortiziae* Pruski. Habit (Monteagudo et al. 13801)



Figure 4 *Munnozia ortiziae* Pruski. Close-up of two capitula (Monteagudo et al. 13801)





Figure 5 A–C. *Munnozia ortiziae* Pruski. Biseriate trichomes of disk corollas (van der Werff et al 17600).

**Distribution and ecology.** This apparently locally common species is endemic to Prov. Oxapampa in Pasco, Peru, where it has been collected in low forests and disturbed areas from 2000–3330 meters elevation in several districts.

*Munnozia ortiziae* is most similar to the Peruvian *M. oxyphylla* of sect. *Munnozia* — both species have pinnately veined, lanceolate to elliptic-lanceolate leaves and moderately large capitula in loose, open cymose capitulescences. *Munnozia ortiziae* clearly differs from *M. oxyphylla* by its subequal or obgradeate (vs. gradeate), tomentose-sericeous (vs. glabrous to lingering arachnoid) phyllaries that are 9–14 (vs. 6–7) mm long, by generally more numerous ray florets, and by funnelform (vs. campanulate) disk corollas with tube shorter (vs. longer) than limb.

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## NEW NAMES IN *DERMATOPHYLLUM* (FABACEAE)

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### ABSTRACT

*Dermatophyllum* is a newly established generic name for a group of taxa centering about *Sophora secundiflora*, a species largely confined to southern Texas and Mexico. The new combination ***Dermatophyllum juanhintonianum*** (B.L. Turner) B.L. Turner, comb. nov. is proposed, the name not otherwise accounted for, and one subspecific name, *Sophora gypsophila* subsp. *guadalupensis* (B.L. Turner & A.M. Powell) Vincent, is elevated to specific status as ***Dermatophyllum guadalupense*** (B.L. Turner & A.M. Powell) B.L. Turner, comb. et stat. nov. Justification for the new nomenclature is provided, along with maps showing distributions.

**KEY WORDS:** Fabaceae, *Sophora*, *Dermatophyllum*

The publication by Gandhi, Vincent, and Reveal (2011), in which the generic name *Dermatophyllum* Scheele is provided for a group of taxa centering around *Sophora secundiflora* Ortega, has occasioned the present paper. The authors provided new generic combinations for all of the taxa except for *Sophora juanhintoniana* B.L. Turner, which was not accounted for in their treatment.

**DERMATOPHYLLUM JUANHINTONIANUM** (B.L. Turner) B.L. Turner, **comb. nov.** *Sophora juanhintoniana* B.L. Turner, Phytologia 76: 385. 1994.

Turner (1994), in the Latin diagnosis of the taxon, compared this gypseous species with the closely related calciphile (so far as known) *Sophora purpusii* Brandegee, the latter possessing smaller leaves and mostly white corollas with larger banners.

It should be noted that *Dermatophyllum juanhintonianum* occasionally occurs on gypsum soils with the more commonly encountered *D. secundiflorum*. At least one putative hybrid between these has been noted (Hinton *et al.* 25155, TEX), this collected with both parents on 9 November 1994, at 1650 m near Aramberi, Nuevo León, and noted by the collectors to be a hybrid. In my opinion, it is likely to be an F1 hybrid, with only a single such plant found at that locality.

**DERMATOPHYLLUM GUADALUPENSE** (B.L. Turner & A.M. Powell) B.L. Turner, **stat. nov.** *Sophora gypsophila* Turner & Powell var. *guadalupensis* B.L. Turner & A.M. Powell, Phytologia 22: 421. 1972. *Dermatophyllum gypsophilum* (B.L. Turner & A.M. Powell) Vincent subsp. *guadalupense* (B.L. Turner & A.M. Powell) Vincent, Phytoneuron 2011-57: 2. 2011.

Turner and Powell (1972) first called attention to this taxon, noting its similarity to the simultaneously described *Sophora gypsophila* Turner & Powell, a taxon occurring on gypsaceous soils in the state of Chihuahua, Mexico, a locality ca 300 km south of the Texas sites. The two varieties differed by numerous characters, including edaphic parameters, the Texas populations occurring in calcareous soils, the Mexican populations in gypsum soils, this all documented by the excellent study



of Northington (1976). Almost certainly, if Turner and Powell had information presented in the latter study, the two taxa would have been treated as distinct species instead of varieties. At least there is no morphological evidence suggesting that the two taxa intergrade, the populations concerned being isolated and occurring in different soil types, without intervening populations.

Northington, Morey, and Van Devender (1977), based upon rat-midden cave materials (dated at ca 16,000 BP) from southern Presidio County, concluded that the species of *Dermatophyllum* in the southwestern USA and northern Mexico are a monophyletic assemblage that possibly differentiated during the Pliocene. Evidence for such speciation events was largely based upon leaflet structure and shape, this depicted in their paper. To me, the latter data are not convincing, largely because the hypothetical “fossil” leaves of *Dermatophyllum* (as pictured) seem too small and isometric to serve as a prototype taxon for the taxa concerned. A presumed ancestor would likely have had much larger, less evenly shaped leaflets. Regardless, such phyletic speculation is based upon relatively little data. It seems more likely to me that the widespread *D. secundiflorum*, with much larger leaflets, gave rise to the rather isolated, smaller populations, which opted for special substrates many eons ago, persisting today as localized edaphic endemics.

The following simplified key provides for the identification of the several taxa discussed here. Their distributions are shown in Figures 1 and 2.

1. Larger leaflets mostly 3–6(–7) cm long; pods woody, cylindric and torose  
..... ***Dermatophyllum secundiflorum***
1. Larger leaflets mostly 0.5–3.0 cm long; pods not woody, flattened.
  2. Larger leaflets mostly 1.0–2.5 cm long; USA, Sonora ..... ***Dermatophyllum arizonicum***
  2. Larger leaflets mostly 0.5–1.0 cm long; Mexico but not in Sonora.
    3. Larger leaves mostly 6–12 cm long; petioles 8–12 mm long; Chihuahua  
..... ***Dermatophyllum gypsophilum***
    3. Larger leaves mostly 3–6 cm long; petioles 4–8 mm long; Coahuila, Zacatecas.
      4. Leaves 3–4 cm long; corollas essentially white, banner ca. 20 mm long  
..... ***Dermatophyllum purpusii***
      4. Leaves 4–6 cm long; corollas lavender, banner ca. 14 mm long  
..... ***Dermatophyllum juanintonianum***

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Guy Nesom and Jana Kos reviewed the paper and provided helpful suggestions. My academic son David Northington provided helpful insight as to the reality of *Dermatophyllum guadalupense*.

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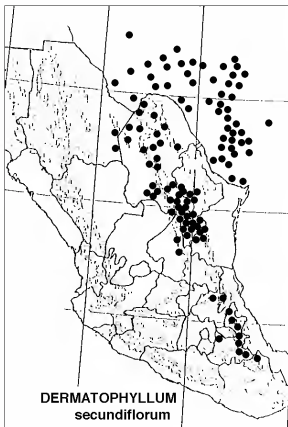


Figure 1. Distribution of *Dermatophyllum secundiflorum*.

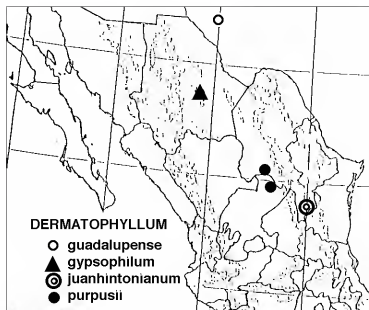


Figure 2. Distribution of the *Dermatophyllum gypsophilum* complex.



**BELLARDIA TRIXAGO (OROBANCHACEAE): 40 YEARS OF RANGE EXPANSION  
IN TEXAS AND A FIRST REPORT FROM LOUISIANA**

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**ABSTRACT**

The naturalized occurrence of *Bellardia trixago*, a species known as adventive to Texas since 1970, is reported and documented for an additional set of counties. Study of the distribution of the species in Texas led directly to its discovery in Louisiana, reported here as new to that state. The collections are mapped by county with symbols to indicate the date of first collection, showing the chronological spread of the species.

**KEY WORDS:** Orobanchaceae, Scrophulariaceae, *Bellardia*, linseed, Texas, Louisiana, USA, adventive

*Bellardia trixago* (L.) All. (Orobanchaceae) is native to the Mediterranean region from Portugal and Morocco east to Turkey, Syria, and Jordan (excluding Egypt but including Mediterranean islands and Madeira and the Azores of the Atlantic Ocean). The species has been introduced to Argentina and Chile (Tropicos.org 2011), Australia (FloraBase 2011), the Canary Islands (Euromed 2011), and the USA. The genus was formerly included as a member of the Scrophulariaceae, in the traditional sense a family consisting of about 275 genera and 5000 species. It is now placed in the Orobanchaceae, which includes the hemiparasitic genera (e.g., *Orobanche*, *Castilleja*, *Pedicularis*, *Seymeria*, and others; see Olmstead 2002 for a summary of the dismemberment of the Scrophulariaceae into at least seven families).

The common name most often used in the USA (Mediterranean linseed) seems to be newly coined, since the species is not native to any English-speaking country. It possibly alludes to the longitudinally ribbed seeds (as described by Polunin 1969), a condition that could be interpreted as “lined.” In error, the name linseed is often rendered as “linsced.” Another common name is “sticky bellardia” and in Spain the species is generally known as *gallocresta* (Spanish, “cock’s comb”).

*Bellardia* in the USA is adventive in California (Weatherwax 1993) and Texas, where first reported from Navarro County by Lipscomb and Ajilvsgi (1982), although a collection from Leon County had been made 10 years earlier (see below). In Texas, *Bellardia* typically occurs along highway roadsides and rights-of-way, vacant lots, and pastures where it is conspicuous by height and color among the colorful spring wildflowers.

Do et al. (1996) provided an account of the expanded distribution of *Bellardia trixago* in Texas to include Anderson, Brazos, Colorado, Freestone, Harris, Henderson, Hill, Kaufman, Leon, Liberty, Limestone, Milam, Montgomery, and Robertson counties. Continued general collecting in the state has resulted in the discovery of the species in additional counties, and new records since the report by Do et al. are documented here. Additionally, Turner et al. (2003) mapped the species in the Ellis, Johnson, Tarrant, and Walker counties but we have not located vouchers for those records.

Voucher specimens. USA. Texas. Austin Co.: NE side of FM 1094, ca. 2.3 road mi NW of jct FM 2187, NW of Seely, locally frequent in sandy loam on gently unshaded roadside through Fayette Prairie, 31 Mar 1999, *Carr 18040* (TEX). Chambers Co.: at intersection of I-10 and Hwy 1406 at Winnie, frequent white-flowered herb on disturbed soil, 29 Mar 1997, *Brown 20144* (TEX). Fayette Co.: SE side of St. Rte. 237, 2.3 road mi NE of jct FM 1291 South, just NE of Warrenton, locally frequent in sandy loam over Oakville Sandstone (Miocene), unshaded grassy roadside through Fayette Prairie, 29 Mar 1999, *Carr 18000* (TEX). Gillespie Co.: Hwy 290, ca. 0.1 mi E of KOA Campground near "25 miles to Johnson City" road sign, N side of Hwy 290, 20 Apr 2005, *Singhurst 13342* (BAYLU). Grimes Co.: FM 105 between Plantersville and Navasota, 6 Apr 2003, *Stancik 64* (BAYLU). Hays Co.: 6 mi E of Dripping Springs on Hwy 290, N side of Hwy 290, 20 April 2005, *Singhurst 13344* (BAYLU). Jefferson Co.: Jct. of I-10 and St Rt 365 at Fannett, Texas, S. side of I-10 and E side of State Rte 365, 28 Apr 2004, *Singhurst 13520* (BAYLU). Kaufman Co.: 2.6 mi. S of jct of Hwy 175 and FM 274, W side of 274 (just W of Cedar Creek Reservoir), 5 May 1995, *Singhurst 3263* (TEX). McLennan Co.: Texas Hwy 31, 1.3 mi W of FR 1330, just west of Axtell, 10 Apr 1999, *Holmes 9924* (BAYLU). Orange Co.: Jct. Hwy 105 and Hwy 73 in West Orange, ca. 0.2 mi S on Hwy 73 and E side of Hwy 73, 29 Mar 2007, *Singhurst 16124* (BAYLU). Parker Co.: U.S. Hwy 180 at jct with FM 113, ca. 12 mi W of Weatherford, 7 May 1998, *Holmes & White* (BAYLU). Rains Co.: State Hwy 47 at Sabine River on Sabine River Authority property, 18 Apr 2000, *White s.n.* (BAYLU). Travis Co.: 0.1 mi S of jct of Slaughter Lane and Hwy 1 (Mopac Expressway), W side of Hwy 1, 13 April 2005, *Singhurst 14181* (BAYLU). Victoria Co.: Goliad, 17 Apr 2010, *Nitschmann 16* (TAMU, fide TAMU 2011). Waller Co.: Hwy 290 West, beside Hempstead/Magnolia exit, FM 1488, 10 Apr 2007, *Idowu 85* (BAYLU).

The species has not been reported in Louisiana by Thomas and Allen (1998), USDA, NRCS (2010), or Neyland (2011) but a brief excursion into Louisiana, barely 16 kilometers east of the locality in Orange Co., Texas, resulted in the discovery of the species, reported here as new to Louisiana. Voucher specimen. USA. Louisiana. Calcasieu Parish: Jct Hwy 109 and I-10, disturbed highway right-of-way in the town of Toomey, northwest corner of jct along access to I-10, 29 Mar 2007, *Singhurst 16125* (BAYLU).

The Louisiana locality is the easternmost record for the species in the USA and an excellent starting point to chronicle the expected spread of the species further eastward. Associated flora at the Toomey locality included introduced and disturbed-site species such as *Cynodon dactylon*, *Bidens alba*, *Bromus* sp., *Centaurium pulchellum*, *Cyperus* spp., *Chloris gayana*, *Nothoscordum bivalve*, *Trifolium* spp., *Medicago* sp., and *Vicia ludoviciana*.

The rapid dispersal of *Bellardia trixago* in Texas over the last 30-40 years is remarkable (Fig 1). Dispersal clearly is along highway corridors, the tiny seeds presumably whipped along by natural winds and by those created by cars and trucks. The most recent movement is southwestern (Gillespie, Hays, and Travis cos.), southern (Victoria Co.), and southeastern (Jefferson and Orange cos., both bordering southwest Louisiana). Movement northward appears to be slower, perhaps indicating ecological limitations.

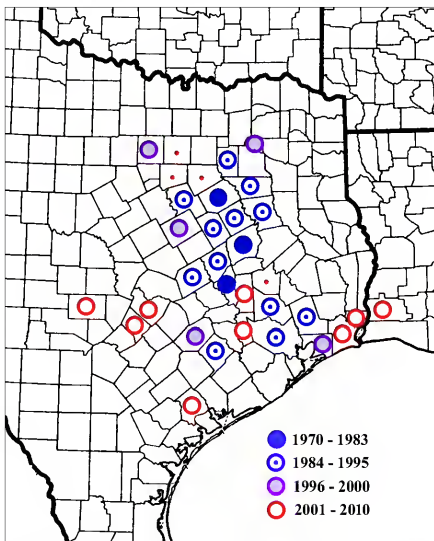


Figure 1. Distribution and chronological spread of *Bellardia trixago* in Texas and Louisiana. Small red dots are records from the Texas atlas by Turner et al. (2003) — vouchers not located in the present study.



Records for the oldest Texas collections mapped on Figure 1 are these. Brazos Co.: W side of roadside of W Loop 2818 at jct of 2818 and Carson Street, 20 May 1983, *Agilvsgi* 8390 (TAMU). Leon Co.: off Hwy 75 at Leona, along roadside, 4 May 1970, *Lundell & Lundell* 18514 (LL). Navarro Co.: open pasture ca. 11 mi SE of Corsicana, 19 Jun 1980, *Agilvsgi* s.n. (SMU).

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## TWO VASCULAR PLANT SPECIES NEW TO OKLAHOMA

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### ABSTRACT

*Calypotcarpus vialis* (Asteraceae) and *Rhynchospora inexpansa* (Cyperaceae) are reported as new to the state of Oklahoma. The *Calypotcarpus* is considered to be a recent introduction, while the *Rhynchospora* is presumed to be native.

**KEY WORDS:** Asteraceae, Cyperaceae, *Calypotcarpus*, *Rhynchospora*, Oklahoma, Bryan County, McCurtain County, floristics, adventive

This paper documents the occurrence of two vascular plant species previously unknown to the flora of Oklahoma.

*Calypotcarpus vialis* Less. (Asteraceae), straggler daisy, is here reported as a recent introduction to Oklahoma, perhaps representing the northern edge of a gradual expansion. Nesom (2011) considered the species as native to Mexico and Texas (“at least to the southernmost counties of the Rio Grande valley, where it is essentially continuous with the Mexican distribution, and possible as far north as Austin (Travis County) along the eastern edge of the Edwards Plateau.”). All other distributions (elsewhere in Texas and the USA, Australia, Taiwan, and Hawaii) are apparently recently adventive.

Voucher specimen: **USA. Oklahoma.** Bryan Co.: 0.5 mi. N of E2190 Rd and Hwy 69, E side of Hwy 69 and 0.9 miles SSW of Colbert, 33° 50' 36.78" N, 96° 30' 46.02" W, 20 Nov 2011, Singhurst & family 18736 (BAYLU).

The Oklahoma record is from Bryan Co., which is contiguous (across the Red River) with Grayson Co., Texas. *Calypotcarpus vialis* is documented from Grayson Co. (Haller *s.n.*, TEX-LL) at a site about 6 kilometers from the Oklahoma locality.

In Oklahoma, *Calypotcarpus vialis* occurred on a flood plain terrace in shady understory of *Acer saccharinum* and *Quercus shumardii* forest. Dominant herbaceous flora growing in association with *C. vialis* included *Carex cherokeenensis*, *Senecio vulgaris*, *Poa annua*, *Viola sororia*, *Allium* sp., and *Laminum amplexicaule*.

*Rhynchospora inexpansa* (Michx.) Vahl (Cyperaceae), the nodding beaksedge, is native to the southeastern USA (Kral 2003), being reported from Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, and Virginia (Kartez 2011; USDA, NRCS 2011). The reported Oklahoma collection is from McCurtain Co., which is contiguous with southwest Arkansas and northeast Texas. In southwest Arkansas, the species has been documented in Miller Co. (*Gentry 9131*, UARK), Lafayette Co. (*Reid 2339*, UARK), and Hempstead Co. (*Lawson 1801*, NLU). In east Texas, the species is known as far north as Marion Co. (*Singhurst & Bridges 14436*, BAYLU). The species occurs in sands, peats, clays, and silts of moist meadows, pond shores, flatwoods, and disturbed low areas (Kral 2003). In eastern Texas, *R. inexpansa* occurs primarily on damp sandy soils in longleaf pine savannas, pitcher plant bogs, flatwood ponds, and disturbed areas (such as sand-based wetlands in maintained clearings for electrical transmission lines).

Voucher specimen: USA, Oklahoma. McCurtain Co.: 0.8 mile W of Tom, on north side of Rd EE, 9 Oct 2008, *Singhurst 16174* (BAYLU).

In Oklahoma, *Rhynchospora inexpansa* occurred in a maintained right-of-way (of an electrical power transmission line) that bisected a low sand hill characterized by water seepage. This site is 60 kilometers west of the nearest known occurrence in Hempstead Co., Arkansas, and 98 kilometers north of the nearest known Texas occurrence in Marion Co. Presently, the Oklahoma record is the most northwesterly known occurrence for the species. Characteristic associated flora included *Bidens aristosa*, *Conoclinium coelestinum*, *Eupatorium serotinum*, *Eupatorium compositifolium*, *Rhynchospora glomerata*, and *Axonopus fissifolius*.

#### ACKNOWLEDGEMENTS

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## PORTULACA UMBRATICOLA (PORTULACACEAE) IN LOUISIANA

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### ABSTRACT

*Portulaca umbraticola* Kunth is documented as occurring in Louisiana. A small population has been found in sandy soil on the Red River floodplain in Shreveport.

**KEY WORDS:** *Portulaca umbraticola*, Portulacaceae, Louisiana

We recently discovered a population of *Portulaca umbraticola* Kunth, also known as Chinese-hat or Wing-pod Purslane, in open sandy soils along the Southern Extension of the Clyde E. Fant Memorial Parkway on the Red River floodplain in Shreveport, Louisiana (Figs 1, 2, 3) and report it here as the first documented occurrence of the species in the state. The population of about 50 plants is restricted to a small area (ca. 0.1 ha). This area, which is adjacent to a bicycle trail and the Parkway, is frequently mowed. We searched several other similar areas on the Red River floodplain but without result. Associated species included *Cenchrus spinifex*, *Chamaesyce maculata*, *Chrysopsis pilosa*, *Coronopus didymus*, *Cynodon dactylon*, *Eragrostis minor*, *Kallstroemia parviflora*, *Mollugo verticillata*, *Oenothera laciniata*, *Paspalum notatum*, *Polygonum aviculare*, *Portulaca oleracea*, and *Tribulus terrestris*.

**Voucher.** Louisiana. Bossier Parish: Shreveport near Southern Extension of the Clyde E. Fant Memorial Parkway centered on 32° 28' 41.00" N, 93° 41' 28.41" W, at about 48 meters elevation, 20 Nov and 1 Dec 2011, *MacRoberts & MacRoberts 8929, 8931* (LSU, LSUS, UNCC).

*Portulaca umbraticola* was reported for Louisiana in the *Flora of North America* survey of *Portulaca* (Matthews 2003). It was not shown as occurring in Louisiana, however, in the accompanying map. No one else has reported this species from Louisiana (MacRoberts 1989; Thomas & Allen 1998; Kartesz & Meacham 2005; USDA Plants 2011; Nature Serve 2011). Consequently we contacted Matthews regarding this matter, and he replied: "I looked at my original distribution maps and I do not have a dot for Louisiana. ... The easiest explanation is that I made a mistake, and that is distinctly possible. With that explanation, then your collection does extend the distribution into Louisiana" (Matthews pers. comm. e-mail, 20 Nov. 2011). Matthews gave us a list of the herbaria from which he had obtained specimens of Louisiana *Portulaca* and we checked these collections either by e-mail or on-line search. None had *P. umbraticola* specimens from Louisiana. The closest location Matthews gives to Louisiana is Panola County, Texas, which is adjacent to Caddo Parish, Louisiana (pers. comm. e-mail, 29 Nov. 2011). The dot map in Turner et al. (2003) shows *P. umbraticola* no closer to Louisiana than Henderson County, Texas, about 200 kilometers west. With the range expansion of opportunistic species over recent years it is not unexpected to find this species in northwest Louisiana. Whether it has been brought into the area by human activity or is expanding its range because of climate change is a matter of conjecture (Chen et al. 2011).





Figure 1. *Portulaca umbraticola* habit.



Figure 2. *Portulaca umbraticola*, showing winged capsules.

The native range of *Portulaca umbraticola* is both North America and South America. Within the USA it occurs in Arizona, Arkansas, Georgia, Mississippi (one location), Missouri, New Mexico, Oklahoma, and South Carolina (Matthews 2003). In Georgia and South Carolina the species is uncommon and is designated as subsp. *corvonta*, while all other populations are designated subsp. *laweolata* (Matthews 2003). According to Matthews, who examined our photographs and a specimen (pers. comm. e-mail 2 Dec. and 12 Dec. 2011), our specimens are *P. umbraticola* Kunth subsp. *laweolata* J.F. Matthews & Ketron (Matthews & Ketron 1991; Matthews et al. 1992).

While this population of *Portulaca umbraticola* occurs on the west side of the Red River, it politically occurs in Bossier Parish; small bits of Bossier Parish occur on the west side of the Red River because the river, which was the original parish boundary in the mid-19<sup>th</sup> century, has changed course through natural meander and man-made alterations ("cutoffs") (Joiner 2006) (Fig. 3). Thus while this *P. umbraticola* population is politically or technically in Bossier Parish, ecologically and biogeographically this area should be considered to be in Caddo Parish until populations are found on the east side of the river.



Figure 3. Aerial showing location of *Portulaca umbraticola* and Caddo-Bossier Parish boundaries.

#### ACKNOWLEDGMENTS

Special thanks to Jim Matthews, who aided with subspecies identification and generously provided background information from his many studies of *Portulaca*. Amanda Lewis (Louisiana State University in Shreveport) aided with the figures. Fred Alford (Chief Deputy Assessor, Bossier Parish) provided the Caddo-Bossier Parish boundary map. Thanks are due Amanda Neill (BRET), Dennis Bell (NLU), and Garne Landry (LAF) who searched their herbaria for *Portulaca umbraticola*.

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**TYPIFICATION OF VARIOUS WESTERN NORTH AMERICAN  
SPECIES OF *JUGLANS* (JUGLANDACEAE)**

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**ABSTRACT**

*Juglans major* (Torr.) A. Heller (1904) was superfluous when published as Heller cited *J. californica* S. Watson (1875) in synonymy. As both authors included *J. rupestris* var. *major* Torr. (1853) in their protologues, only by lectotypification is it possible to render *J. major* legitimate. Accordingly we propose (1) a step-two lectotypification for var. *major* on a specific Samuel W. Woodhouse specimen (NY), following the step-one lectotypification by Heller on this gathering, and (2) the lectotypification of *J. californica* on the William H. Brewer (no. 65) specimen (GH) mentioned by Callahan (2008) as the “type.” Only in this way is it possible for *J. major* and *J. californica* to be correct when the two are considered to represent different species. In addition, lectotypes are designated for *J. microcarpa* Berland. (*J.L. Berlandier* 2459, US), *J. nana* Engelm. (*F.J. Lindheimer* 1178, MO) and *J. rupestris* Engelm. ex Torr. (*J.M. Bigelow s.n.*, NY). The latter overturns an earlier typification by Wolf (1988) on a specimen not seen by Torrey. *Juglans nana* and *J. rupestris* are synonyms of *J. microcarpa*; all three types were gathered in western Texas. Typification of five Dode names is discussed briefly. *Juglans arizonica* and *J. elaeagnifolia* were recently lectotypified by Mauz (2011); isotypes of *J. subrupestris* have been seen but a holotype has not been located. Lectotypes are designated here for *J. neomexicana* and *J. torreyi*. Isotypes and isolectotypes are reported when appropriate.

**KEY WORDS:** lectotypification, step-two lectotypification, *Juglans*

When Heller (1904: 50) proposed *Juglans major* (Torr.) A. Heller (Juglandaceae), based on *J. rupestris* var. *major* (Torrey 1853: 171), he cited in synonymy *J. californica* (Watson 1875: 349) thereby rendering his name nomenclaturally superfluous when published. Fortunately, the 2006 *International Code of Botanical Nomenclature* (McNeill et al. 2006) states that a superfluous name is legitimate if its type differs from that of the name that ought to have been adopted (Art. 52). *Juglans rupestris* var. *major* Torr. and *J. californica* S. Watson are hereby lectotypified so as to render *J. major* legitimate. This then allows the continued use of both names as they are applied in a wide variety of today's systematic literature (e.g., Kearney & Peebles 1951; Munz 1974; Martin & Hutchins 1980; Hickman 1993; Whittemore & Stone 1997) and non-systematic literature (e.g., Harker et al. 1999; Johnson 1999; Cullina 2002; Fralish & Franklin 2002; Preston & Braham 2002; Thompson et al. 2006; Moerman 2010).

In our attempt to resolve the above problem, we found it necessary to examine the typification of other names. Lectotypes are designated here for *Juglans microcarpa* Berland. (Berlandier 1850: 276), *J. nana* Engelm. (Engelmann 1851: 226), and *J. rupestris* Engelm. ex Torr. (Torrey 1853: 171). Five other species names, all proposed by Dode (1907, 1909) and synonyms of *J. major* or *J. microcarpa* (Manning 1957), are discussed briefly. Lectotypes are designated here for *J. neomexicana* (Dode 1909: 169, 191) and *J. torreyi* (Dode 1909: 169, 194). Two of the other Dode names, *J. arizonica* (Dode 1909: 169, 193) and *J. subrupestris* (Dode 1909: 169, 191), were typified by Dode. *Juglans elaeopyren* (Dode 1907: 247) was lectotypified recently by Mauz (2011).

#### Lectotypification of *Juglans rupestris* var. *major* Torr.

Torrey (1853: 171) simultaneously proposed *Juglans rupestris* (a synonym of *J. microcarpa*, fide Johnston 1944: 436) and its var. *major*, characterizing the species as a shrub or small tree with the leaflets of var. *major* longer and broader ("oblong-lanceolatis" [sic]) than those of var. *rupestris* ("lanceolatis"—compare figs. 15 and 16 in Torrey; see also figs. CCCXXXV and CCCXXXVI in Sargent [1895]). In his protologue, Torrey stated that Samuel W. Woodhouse found var. *major* in "western New Mexico" and Dr. John Milton Bigelow "collected it at the Copper Mines."

The Woodhouse specimen in the Torrey Herbarium at NY was annotated by Torrey "Juglans rupestris β." However, we have not found a specimen at GH, NY, or US that we can associate unequivocally with "Bigelow" and a "copper mine." The available sheets that were gathered by Bigelow are all Texas collections of *J. microcarpa*.

The only sheet we found in the Torrey Herbarium (NY) from the vicinity of a copper mine is an "Ex coll. Geo. Thurber" sheet numbered 702, gathered 3 Jul 1852. The specimen was collected in Santa Cruz Valley in what is now Pima Co., Arizona, based on the information on the GH sheet, which has "702 / large tree. Sta Cruz Valley / July 1852 / G.T." written by George Thurber. We have also seen two other sheets at NY (general herbarium) dated 3 Jul 1852 that have printed labels entitled "Mexican Boundary Survey." As both Thurber and Bigelow were botanists with William H. Emory on the Mexican Boundary Survey in 1852 (McKelvey 1955) it is possible the "Ex coll. Geo. Thurber" sheet was gathered by Bigelow as stated by Torrey, but given what is on the GH sheet we suspect Torrey simply received the specimens from Bigelow, and 702 is actually a Thurber gathering. Critical to our discussion here is that Torrey (1859: 205) later assigned material from the "Copper Mines" to var. *rupestris* noting that var. *major* "seems to pass gradually into the small-fruit form" of his var. *rupestris*. As stated by Wootton and Standley (1915: 162) the Woodhouse collection certainly came from modern-day Arizona. They also noted that the plant growing in the Santa Cruz Valley of southern Arizona, where the copper mines were located, was a "good-sized tree, not infrequently with a trunk 3 to 4 meters to the first branch."



Torrey's observation of the fruit in 1853 is critical because in the original description of var. *major* Torrey wrote "fructibus subovato-globosis apiculatis leviter sulcatis." He distinguished var. *rupestris* as "fructibus globosis [sic] compressiusculis glanduloso-pubescentibus; nucē longitudinaliter sulcato; putamine creberrimo." As the extant Woodhouse sheet lacks fruit, the fruit of var. *major* described by Torrey could only have been derived from his Thurber specimen, and as Torrey questioned the inclusion of this element in 1859, one might then assume that Torrey himself restricted his concept of var. *major* to the fruitless Woodhouse collection. This may account for Heller's (1904: 50) statement that the "type of *J. major* came from western New Mexico, collected by Dr. Woodhouse." In doing so, Heller effectively proposed the Woodhouse gathering as a lectotype (step-one); here we propose a step-two lectotypification by designating a specific herbarium sheet:

***Juglans rupestris*** Engelm. ex Torr. var. ***major*** Torr. in L. Sitgreaves, Rep. Exped. Zuni & Colorado Rivers 171, pl. 16. Mar-Apr 1853. TYPE: Arizona. "Western New Mexico," without location or date, *S.W. Woodhouse s.n.* (lectotype, step 1, designated by A.A. Heller, Muhlenbergia 1: 50. 1904, NY! [bar code 00214588], designated here. [= *J. major* (Torr.) A. Heller, Muhlenbergia 1: 50. 22 Feb 1904]).

As now defined, *Juglans major* var. *major* is found in western Arizona, southern New Mexico, and southwestern Texas south into Sonora, Chihuahua, Durango, and Sinaloa, with disjunct populations ranging from central Texas to central Oklahoma (Little 1976; Whittemore & Stone 1997; BONAP 2011). Other varieties of the species extend its range south to the Mexican states of Michoacan, Mexico, Jalisco, and Guerrero.

#### Lectotypification of *Juglans californica* S. Watson

When Watson (1875) proposed *Juglans californica* he cited no specimens but mentioned Torrey's *J. rupestris* var. *major*, a name associated with at least two syntypes, a Woodhouse collection from "western New Mexico" and a "Bigelow" (actually Thurber) collection from the "Copper Mines" of Santa Cruz Valley in modern-day Arizona (see above). Peter (1876: 1366) considered *J. californica* equal to Torrey's var. *major* in his brief review of the Watson paper, implying perhaps that Watson provided a new name for var. *major*. Rothrock (1879: 249) and Sargent (1880: 42) also cited var. *major* as a synonym under *J. californica*, but later Sargent (1884: 131) assigned both to *J. rupestris*; this latter view was followed by Parish (1894: 345). Nagy (1886: 382–383) considered *J. californica* to be a later name ("Juglans californica Wats., später neuerdings als Jugl. rupestris major v. Torrey beschrieben" [*Juglans californica* Wats. was described recently for Jugl. rupestris major Torrey]) for var. *major*. None of these actions resolved the nomenclatural status of *J. californica* relative to var. *major*, nor were any of these statements an effective typification of either name. In addition to the Woodhouse and Thurber gatherings, Watson also had before him at least three or four other elements, (1) a sterile John Torrey collection (485, GH!, NY!) from near Santa Barbara, California, gathered in 1865; (2) a William H. Brewer collection with fruit obtained in the "Sierra Santa Monica" of Los Angeles Co., California, in 1860 (GH[2]); and (3) an A. Kellogg & W.G.W. Harford 902 (30 Apr 1868, GH, NY[2]) collection with only "California" given as a location. Watson also likely had access to an unnumbered and undated Bolander collection labeled "San F." (GH!).

As defined by Watson (1875), the species ranged from "the vicinity of San Francisco ... southward to Santa Barbara, Southern Arizona and Sonora." His "San Francisco" reference is almost certainly based on the Bolander and the Kellogg and Harford gatherings; both are in anthesis and are now assigned to *J. hindsi* (Jeps.) Jeps. ex R.E. Sm. (Smith 1909). His reference to Santa Barbara was clearly based on *J. Torrey* 485. The Sonora, Mexico, reference was based on a Thurber specimen (GH!). Curiously, none of these specimens was annotated by Watson. Writing in the work known as "Botany of California," Watson (1880: 93) essentially gave the same distribution that he did in 1875 only this time he added "Thurber" without any explanation. It is possible that Watson was aware of

the sheet numbered 702, gathered in Santa Cruz Valley in 1852, but simply failed to mention this collection of var. *major* when he proposed *J. californica*. Watson probably was not aware of a collection gathered by Charles C. Parry from the San Fernando area near Los Angeles in 1850 (NY!, US!) although a small leaf fragment is at GH!; Parry labeled his US sheet “*Juglans rupestris*. Eng. var” and wrote “fruit larger, less sculptured than the Texas form.” The NY sheet is in flower while the US sheet has fruit. Accordingly, we propose the following lectotype:

***Juglans californica*** S. Watson in Proc. Amer. Acad. Arts 10: 349. Apr 1875. TYPE: California. Los Angeles Co.: “Sierra Santa Monica [=Santa Monica Mountains], 1860-1862 [=18 Dec 1860], W.H. Brewer 65 (lectotype, designated here: GH! [bar code no. 00033626]; isocototypes: GH![frag.], UC! [2 sheets, herb. nos. 5314 and 5319]!, US!).

The Dode (1909: 195) statement “La localité type citée S. Watson, Santa Barbara,” which alludes to the Torrey collection, is fortunately not a declaration of a lectotype. The statement by Callahan (2008: 43) that the “type specimen, collected in December 1860 by W.H. Brewer (#65) from Sierra Santa Monica, California, is now stored in Gray Herbarium at Harvard University” was also not an effective lectotypification (Art. 7.11; McNeill et al. 2006) but his suggestion is accepted here.

The geographical range of *Juglans californica* was gradually restricted to just a portion of California (Sargent 1895: 130; Hough 1899: 46; Jepson 1901: 146; Orcutt 1902: 146, 1907: 96). The information was summarized by Jepson (1908), who confined var. *californica* to southern California and established var. *hindsii* Jeps., named for Brinsley Hinds, who found the plant along the Sacramento River in 1846 (K!), for the northern California populations of the Central Valley. This view was basically repeated by Sudworth (1908: 208) and Jepson (1909a: 365, 1909b: 145–147; 1910: 192–196), with Smith (1909: 27) proposing *J. hindsii*, a combination not mentioned by Jepson (1910, 1911) until much later (Jepson 1923: 109, 1924: 69–70, 1925: 279). In fact, the combination was attributed to Sargent (e.g., Babcock 1916) or Rehder (e.g., Sudworth 1927: 50), based on the isonym *J. hindsii* Sarg. ex Rehd. (in L.H. Bailey, Stand. Cycl. Hort. 3: 1722. 1915), even though Smith (e.g., 1912) and others (e.g., Wylie 1920; Pratt 1922: 110) used *J. hindsii* in their publications with Jepson as the authority. Today, *J. hindsii* is generally accepted (Whittemore & Stone 1997) although Wilken (1993: 709) maintained var. *hindsii* in his treatment for the Jepson Manual.

The taxonomic application of *Juglans californica* to a coastal shrub or small tree (up to 15 m tall) of California (Little 1976; Whittemore & Stone 1997; BONAP 2011), and *J. major* for a somewhat larger shrub or tree (up to 18 m tall) found well to the east of *J. californica*, essentially has been unchanged for nearly a century. Our lectotypifications allow the names *J. californica* and *J. major* to remain in current use. Should the two names be combined then *J. californica* has priority. Should one assign var. *major* to *J. microcarpa* then the combinations *J. microcarpa* var. *major* (Torr.) L.D. Benson (1954: 110) and subsp. *major* (Torr.) A.E. Murray (1984: 11) become available.

#### Lectotypification of *Juglans microcarpa* Berland.

The description of *Juglans microcarpa* is at best minimal:

A la orilla de los torrentes, y sobre todo, en la del arroyo principal, se encuentran nogales de una especie natural, cuyos frutos muy pequeños, parecidos a una grande avellana, tienen un *Endocarpo* muy duro, y por esto se ha descrito bajo el nombre de *Juglans Microcarpa* [Along the border of the torrents, and mainly, in one of the main streams, are walnuts of a natural species, whose very small fruits, resemble a great hazelnut, they have a very hard *Endocarp*, and for this it has been described under the name of *Juglans Microcarpa*]

The above is at least diagnostic and not different all that much from Engelmann's characterization of *Juglans nana* ("nuts of the size of a musket ball"—see below) but is sufficient to distinguish this species of walnut from all others in North America. The travels of Berlandier in late 1828 are covered only briefly by McKelvey (1955: 898) but at least a translation of the Berlandier and Chovell's diary is informative (Kaye 2010), so that the 1828 location can be rather precisely stated. Thus, Berlandier's observation of *J. microcarpa* was made along the Frio River west of Utopia in an area known historically as Arroyo de la Soledad until a 1790 battle, when the site was renamed "Cañon de Ugalde" in honor of the Spanish general Juan de Ugalde (1729–1816) who was governor of Coahuila (Wade 2003: 213; Starnes 2011). A collection from this area has not been found, but other Berlandier specimens are extant.

Berlandier's 1851 diary does not mention his later travels in Texas, but certainly his extant specimens (*Berlandier 2459*, GH, NY, PH, US), gathered in 1834, and an undated specimen (*Berlandier 2275*, G, bar code G00305360) were available to him when his diary was published in 1851. Thus, we consider these collections to be original material and available for lectotypification. A critical examination of *Berlandier 2459* shows this to be typical material of *Juglans microcarpa*, but *Berlandier 2275* is a gathering of *J. major*. The latter collection came to Geneva via the 1908 donation of the Moïse-Étienne Moricand herbarium and not directly from Berlandier, whose primary set of specimens is at G (Staffleu & Cowan 1976: 196).

The role of Berlandier in the botany of Texas and the fate of his collections and manuscripts were reviewed in some depth by Geiser (1933; see also McKelvey 1955: 378–381). As a result we propose the *Berlandier 2459* as the type and cite the location and date taken from labels on his specimens. However we must note that the sheet at GH, which consists of a single specimen, bears two labels. One gives the location as Rio de Medina and the date simply as 1834. A second bears the number 1029 with "De Mortamoras a Goliad" and a date of "April 1834." This implies that the collection was gathered somewhere between Matamoras, Tamaulipas, Mexico, and Goliad in Goliad County, Texas. However, this is well out of the known distribution of *Juglans microcarpa*, and thus this label is discounted. We suspect the Berlandier sheets at GH, NY, PH, and US most likely were obtained by Lieutenant D.N. Couch, who purchased "the entire collection of notes and specimens left by Doctor L. Berlandier" when Couch was in Matamoras (Baird 1855: 87).

In a fragment packet on this sheet we also found a letter to Asa Gray, dated 11 Jan 1853, written by Dr. Edward Foreman, assistant to the Secretary Joseph Henry of the Smithsonian Institution. The letter was wrapped around a single walnut.

Dear Sir:

An accompanying dried plant has been sent from Austin Texas [so] that is [sic, its] name may be ascertaining, also the little nut. Prof. Henry directs me to send them to you for this [e.g., your identification] – Also please state in your answer what is the botanical name of the Comal of which we have received seeds

On my own account I would take the liberty to say that the continuation of your Flora of N. Am. is much wanted & would probably save you many troublesome applications like this present one.

This is all rather confusing. In 1853, Forman was no longer with the Smithsonian but rather had been appointed Chief Examiner for the Patent Office in 1852 and did not return to the Smithsonian until 1874 (Baird 1886: 24). Furthermore, references to both Austin and to Comal strongly suggest the material was gathered by Lindheimer, as "Comal" is the name of the county where Lindheimer lived. Yet, the "dried plant" on the GH sheet is associated with the two Berlandier labels. We believe the nut, specimen, and labels all represent material gathered by Berlandier.

*Juglans microcarpa* Berland. in J.L. Berlandier and R. Chovell, *Diario Viaje Comis. Limites* 276. 1850. TYPE: Texas. Bexar Co.: Río de Medina, Jun 1834, J.L. Berlandier 2459 (lectotype, designated here: US!; islectotype: GH!, NY!, PH!).

*Juglans microcarpa* occurs from north-central New Mexico east to south-central Kansas south through much of central and eastern New Mexico and western Texas into Chihuahua, Coahuila, and Nuevo León, Mexico (Little 1976; Whittemore & Stone 1997; BONAP 2011).

#### Lectotypification of *Juglans nana* Engelm.

When George Engelmann (1851) described this species it was, admittedly, a bit off-handed: “a shrub, that bears nuts of the size of a musket ball.” This simple statement is still diagnostic, for Whittemore and Stone (1997: 427) report the nut of this species to be a mere 1.1–1.7 cm in diameter—the smallest nut of any North American species of walnut. Engelmann commented on the “beautiful collections of my friend Ferdinand Lindheimer, together with his very full notes” (p. 223), and wrote a paper read at a session of the American Association for the Advancement of Science on 9 May 1851. That paper was published sometime between late August and December of 1851.

The name *Juglans nana* probably did not originate with Engelmann. In a letter dated 9 October 1846, Lindheimer wrote (as translated) “More fruit specimens of *Juglans nana* will [be] following” (fide, Goyne 1991: 168). Indeed we have seen *Lindheimer* 535, fasc. III found in 1846 (GH!, NY!, PH!, US!). The GH sheet bears an original handwritten label suggesting that the collection was made in May of 1846. We have also seen a September 1845 collection from “the gravelly banks of the upper Guadalupe [sic] etc.” gathered by Lindheimer (GH!) with the name “*Juglans fruticosa* n sp” on the label. There is also an April 1851 label suggesting that Lindheimer found the plant “on gravelly river banks and in dry creek beds, Guadalupe[e].” A third printed label (*Lindheimer* 480, Fasc. III. 1846) is also added to the same sheet; we are uncertain which label goes with which specimen.

A specimen at MO can be associated with this name, namely a Lindheimer collection with a label bearing a printed location (“Comanche Spring: New Braunfels, etc.”) stating this is one of the plants “Collected by Lindheimer from 1849 to 1851.” Also printed on this label are a collection date (“May 1849”) and a collection number (“No. 1178”). Above that label on the MO sheet is what we believe to be Lindheimer’s original label. This one is only partially printed (“FLORA TEXANA” [top], “*Hab.*” [lower left], “Ferd. Lindheimer leg. [bottom left], and “18” [bottom right]. In pen is a number “20” (upper left, perhaps Lindheimer’s original number), the name “*Juglans rupestris*?” and in the lower right “May” and “49” after the printed number “18.” One of the sheets at GH also bears the number “20” but here the date is given at “April 1849.” We consider this to be a lapsis for May. Accordingly we designate a lectotype for *Juglans nana*:

*Juglans nana* Engelm. in Proc. Amer. Assoc. Advancem. Sci. 5: 226. Aug-Dec 1851. TYPE: Texas. Kendall Co.: Comanche Spring, May 1849, F.J. Lindheimer 1178 (lectotype, designated here: MO! [sheet no. 210374]; islectotype: BM!, GH[2]!, NY, PH[2]!, US!).

*Juglans nana* is a synonym of *J. microcarpa*.

#### Lectotypification of *Juglans rupestris* Engelm. ex Torr.

Wolf (1988: 1630) declared the “type” of *Juglans rupestris* to be the lectotype we have designated here for *J. nana*, in the mistaken belief that Engelmann validated the name. This is not the case. Furthermore there is no evidence that *Lindheimer* 1178 was even seen by Torrey (1853: 171) because of what he wrote:

I first received specimens of this plant from Dr. J. M. Bigelow, when he was attached, as botanists, to the Mexican Boundary Commission, in 1850. He thought it was probably a new species, and wished me, in case it should prove to be undescribed, to name it *J. Whippleana*, in compliment to Lieut. Whipple, who was also a member of the Boundary Commission. Accordingly I read an account of it, under this name, before the American Scientific Association, in August, 1851, but the description was not published. Afterwards I was informed that Dr. Engelman had obtained the plant before me, and had already named it *J. rupestris*, which name is therefore adopted.

In fact, Engelman (1851: 226) named the species *Juglans nana*, not *J. rupestris*, and furthermore Torrey's intended paper, entitled "On two new species of *Juglans*," was indeed marked as "Not received" in the summary of the meeting held in Albany, New York (Baird 1852: 307). Torrey wrote in 1853 that he "received from Dr. Woodhouse, and also from Dr. Bigelow, specimens of what I at first took for a second new species of *Juglans*" — this confirms that by 1851 Torrey probably had at least three elements at hand, one or more 1850 Bigelow gatherings from Texas that he considered to represent *J. rupestris*, and two more western specimens of what he termed, in 1853, *J. rupestris* var. *major*. The Bigelow gatherings from western Texas are critical, for today there are two sheets at NY confirming Torrey's use of the word "specimens" in the above quote. One has a handwritten label that states "Juglans Whippleana. Gravelly bed of Stream from Devil's River to the Pecos" (NY, bar code 00214587) while the second has a printed Mexican Boundary Survey label bearing in pen "*Juglans rupestris*. Engelm. Rio San Pedro (Devil's River). Western Texas. Dr. Bigelow, Oct 1850." The first specimen (which is not dated and lacks a collector's name but almost certainly is a Bigelow collection) lacks mature fruit whereas the second specimen with the printed label has several fruits.

Not mentioned by Torrey, but in his personal herbarium, were two additional collections of *Juglans microcarpa*. One is a Josiah Gregg collection (NY) gathered in Mexico. The second is a Charles Wright collection (NY) but it is not dated; duplicates are at GH! and PHI!. Another probable syntype is a Bigelow collection from the "Second Crossing, Devils River" gathered on 3 Nov 1850 (GH!, bar code no. 0003632; NY!). It is possible that this collection is a duplicate of the one Torrey received that was annotated "Juglans Whiplianus" (NY, bar code 00214587). The remark "Second Crossing" and a later date suggest that this is not a duplicate of our lectotype. We have also seen Wright 363 (May-Oct 1849; GH![2], K!, US!) and Wright 1863 (1851-1852, US!), both specimens of *J. microcarpa*, and Wright 1862 (1851-1852, US!), a collection of *J. californica*. A sheet at GH! numbered 1862 bears a label by Wright that states "Limpio Valley – Texas." As none of the Wright material was available to Torrey, none is considered to be original material.

We have also seen a collection numbered 1369 at NY and US (bar code no. 00888534) with a printed label that indicates the material was gathered "chiefly in the Valley of the Rio Grande, below Doñaña—by C.C. Parry, M. D., J.M. Bigelow, M. D., Mr. Charles Wright and Mr. A. Schott." This is of *Juglans microcarpa* as well. Since there is no direct evidence that this gathering was seen by Torrey prior to publication of his name, we do not consider these sheets to be original material. No such sheet is at GH!

In view of Torrey's inclusion of characters of both leaves and nuts for *Juglans rupestris* in his protologue, and of his specific reference to Bigelow, we hereby designate the following lectotype:

***Juglans rupestris* Engelm. ex Torr. in L. Sitgreaves, Rep. Exped. Zuni & Colorado Rivers 171, pl. 15. Mar-Apr 1853. TYPE:** Texas, Val Verde Co.: Rio San Pedro (Devil's River), Oct 1850, J.M. Bigelow s.n. (lectotype, designated here: NY! [bar code no. 00214586]; isoclectotype: NY! [bar code 00214587].



*Juglans rupestris* is a synonym of *J. microcarpa*.

### Lectotypification of two Dode (1909) names in *Juglans*

Dode (1907; 1909: 191–195) proposed five names now considered to be synonyms of *Juglans microcarpa* or *J. major* (Manning 1957: 136–140). Mauz (2011: 128) noted that the holotype of *J. arizonica* Dode (1909: 169, 193) is a C.G. Pringle s.n. collection from the Santa Rita Mountains of Pima or Santa Cruz County, Arizona, gathered on 11 Jun 1884 (holotype: P! [bar code P005065583]; isotypes CMI!, FI, NY/WAB!, PHI!, US! = *J. major*). She also designated a lectotype for *J. elaeopyren* Dode (1907: 247), namely another unnumbered Pringle collection, this one from the Santa Catalina Mountains of Pima Co., Arizona, obtained on 17 May 1881 (lectotype: G! [bar code 103606/1]; isoelectotypes: A!, ARIZ!, CMI!, FI, G! [3], GH!, MO!, NY!, PHI!, US [2]! = *J. major*, fide LaFerrière 1994: 219).

We can now report on a third species:

***Juglans subrupestris*** Dode. Bull. Soc. Dendrol. France 13: 169, 191. 15 Aug 1909. TYPE: Texas. Without location, 1847, F.J. Lindheimer 704 (holotype not found; isotypes: GH! [2], K!, NY!; US [2]! = *J. microcarpa*)

A sheet seen and annotated as *Juglans subrupestris* by Dode, and therefore the probable holotype, might be at P. At the moment, specimens of *Juglans* are not available due to ongoing renovations (P.P. Lowry, pers. comm.). Curiously, this collection is not at MO (Blankinship 1911: 155). The plant could have been collected near present-day Llano, Llano Co., Texas, where Lindheimer resided for at least part of 1847 (Goyne 1991: 180) or more likely it was gathered in the Fredericksburg area near the Pedernales River in Gillespie Co. (Geiser 1937: 170; McKelvey 1955: 903), where the walnut is found today.

Lectotypes are required for the following two names proposed by Dode:

***Juglans neomexicana*** Dode, Bull. Soc. Dendrol. France 13: 169, 191. 15 Aug 1909. TYPE: New Mexico. Lincoln Co.: White Mts., 19 Aug 1897, E.O. Wooton 362 (lectotype, designated here: P! [bar code no. P00506584]; isoelectotype: NY!, P! [bar code no. P00506585], RMI!, US! = *J. microcarpa*).

Our designation of the Wooton specimen allows *Juglans neomexicana* to remain a synonym of *J. microcarpa* as the other syntype (Arizona, Coconino Co.: near Flagstaff, 12 Jul 1898, D.T. MacDougal 271, GH!, NY!, NY/DPUI!, PHI!, US!) is a collection of *J. major* and, obviously, not from New Mexico.

***Juglans torreyi*** Dode, Bull. Soc. Dendrol. France 13: 169, 194. 15 Aug 1909. LECTOTYPE, designated here: C.S. Sargent, Silva N. Amer. 7: t. CCCXXXVI. 1 Feb 1895. = *J. major*).

Dode (1909: 194–195) did not accept *Juglans rupestris* or *J. major*, treating both as pro parte names of *J. californica* and *J. torreyi* for reasons not entirely true:

Sous le nom de *J. rupestris*  $\beta$  *major*, Torrey n'entendait pas seulement l'espèce qu'il a figurée (*loc. cit.* [e.g., C.S. Sargent, Silva N. Amer. 7: t. CCCXXXVI. 1 Feb 1895]) et dont il s'agit ici, mais aussi *J. californica*. Lorsque ce dernier a été spécifiquement 'établi, la synonymie *J. rupestris major* a été donnée, non sans raison. Le caractère des anthères pubescentes (non encore signalé, croyons-nous) suffit à le séparer facilement de *J. rupestris* et de *J.*

*californica*. [Under the name *J. rupestris*  $\beta$  *major*, Torrey not only treated the species in question here, but also *J. californica*. When the latter was established, the synonym *J. rupestris major* was given without reason. The character of the pubescent anthers (not yet reported, we believe) is enough to easily separate it [*J. torreyi*] from *J. rupestris* and *J. californica* ]

As mentioned above, Torrey (1853: 171) alluded to only two collections under his var. *major*. Six years later, also as mentioned above, Torrey (1859: 205) considered the Bigelow collection to be an expression of var. *rupestris* rather than var. *major*. At no time did Torrey ever allude to any element of *J. californica*. Clearly, Dode confused Torrey's efforts with what Watson did more than two decades later. Given the nature of the name and the distribution of *J. torreyi* and the citation of the 1895 Sargent plate, the lectotype of *J. rupestris* var. *major* clearly falls within *J. torreyi*. By lectotypifying Dode's name on the cited Sargent plate, *J. torreyi* is at least legitimate while the question of whether or not this name was superfluous when published is left unresolved. Manning (1957: 138) suggested that this name was "based on plants cultivated in France" as Dode (1909: 195) mentioned "Cultivé: ALLARD, Angers (fructifiant)," but our choice of a lectotype ensures application of the name.

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**A STEP-TWO LECTOTYPIFICATION AND EPITYPIFICATION  
OF *PENTAPTERYGIUM SIKKIMENSE* W.W. SM. (ERICACEAE)  
WITH AN AMPLIFIED DESCRIPTION**

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**ABSTRACT**

An epitype is selected for *Pentapterygium sikkimense* W.W. Sm., the basionym of *Agapetes smithiana* Sleumer, to augment the inadvertent lectotypification by Airy Shaw (1959) on a G.A. Gammie collection from Sikkim, India. A step-two lectotypification on the specimen at Kew is designated here. An amplified description of var. *smithiana* is provided. Photographs of the lectotype, isolectotype, epitype, and live plants are provided to facilitate identification.

**KEY WORDS:** typification, Sikkim, West Bengal, India.

*Pentapterygium sikkimense* was described by William Wright Smith (1911: 268) based on specimens collected by George Alexander Gammie in 1892 (1216, K! [Fig. 1], CAL! [Fig. 2]) from Lachung Valley in the state of Sikkim, and by Charles Gilbert Rogers in 1899 (accession no. 264374, CAL!) from the lower Tonglu region of the Darjeeling Himalaya in the state of West Bengal, India. Sleumer (1939: 106) transferred *P. sikkimense* to *Agapetes* D. Don ex G. Don and proposed a new named, *A. smithiana*, because the Smith epithet was blocked by *A. sikkimensis* Airy Shaw (1935: 29). Years later, in a casual remark made in passing, Airy Shaw (1959: 489) effectively performed a step-one lectotypification of *P. sikkimense* by considering the Gammie collection to the “type.” Here we designate the sheet at the Royal Botanic Garden at Kew in a step-two lectotypification. Unfortunately, the lectotype is devoid of floral parts, except for the calyx, and based only on vegetative features this specimen could be confused with *A. interdicta* (Hand.-Mazz.) Sleumer or *A. borti* Airy Shaw. Likewise, *A. smithiana* is subdivided into two varieties, var. *smithiana* with a corolla 10–13 mm long, and var. *major* Airy Shaw (1959: 489) with a corolla 17–21 mm long. Only by consulting Smith original description can one learn that the specimens he examined either had a corolla “1 cm longa” or in some way he knew the corolla was that length. Hence, for the purpose of the precise application of the name an epitype (Art. 9.7, McNeill et al. 2006) is proposed. The epitype (Fig. 3) was obtained during the course of recent field studies in Singalelah National Park, Darjeeling Himalaya, Sikkim, India, when specimens of *Agapetes smithiana* were collected near Chitrey along a rocky slope.



# Taxonomic treatment

*Agapetes smithiana* Sleumer in Bot. Jahrb. Syst. 70: 106. 1939, a new name for *Pentapterygium sikkimense* W.W. Sm. in Rec. Bot. Surv. India 4: 268. 1911. TYPE: INDIA. Sikkim, North District: Sikkim Himalaya, Lachung Valley, 7500 ft elev, 14 Sep 1892, G. A. Gammie 1216, designated by Airy Shaw in Kew Bull. 13: 489. 1959 (lectotype [designated here]: K! [barcode no. K000729429]; isolectotype: CAL! [acc. no. 264376]). Figs. 1, 2. EPITYPE (designated here): INDIA. West Bengal. Darjeeling District: Darjeeling Himalaya, Singalila (or Singaleh) National Park, 3 km NW of Chitrey (or Chitre) along Singalila Ridge Trek to Meghma, 2650 m elev, ca 27° 00' 25" N, 88° 05' 25" E, 11 Dec 2011, S. Panda 81 (CAL!). Fig. 3.

Airy Shaw (1959: 489) distinguished *Agapetes smithiana* var. *major*, known from Bhutan, based on differences in the corolla size as may be seen in the key below. Here, for the record, we have amplified the description of var. *smithiana* based on field observation of live plants from Darjeeling Himalaya as well as available herbarium specimens at CAL.

1. Corollas 10–13 mm long, 3.5–4.5 mm in diameter ..... var. *smithiana*  
 1. Corollas 17–21 mm long, 6–9 mm in diameter ..... var. *major*

## var. *smithiana* (Fig. 4)

Plants usually epiphytic on tree trunks or rarely in rock crevices, 0.1–0.4 m long. Stems rigid, terete, lenticellate, sparsely strigose-hispid; branches similar to stems but beset with dense brown strigose-hispidulous to hirtellous hairs (more towards twigs); perulae 3–9, alternate. Leaves compactly 2–3-stichous, 2–10 mm apart, coriaceous, subsessile; petioles 1–3 mm long, puberulous; lamina elliptic-obovate to obovate, 12–32 × 6–16 mm, glaucous and green adaxially, glabrous and light green abaxially, serrate with minute teeth to 0.5 mm long, these becoming obscure near basal half, incurved marginally, mucronate to mucronulate apically, cuneate to obtuse basally with one basal pair of glands; venation brochidodromous with 5–8 pairs of lateral veins, these often obscure adaxially but conspicuous and slightly raised abaxially. Inflorescence cauline, 1–4-fascicled in a corymb; peduncle 3–5 mm long, sparsely hirtellous with several basal bracts. Flowers 13–16 mm long including pedicels with bract and bracteoles; pedicels greenish-pink, sparsely hirtellous, 4–5 mm long; bract 1, basal, 1 × 0.5 mm, ovate-triangular, glabrous, caducous; bracteoles 2–4, basal to subbasal, persistent in fruit, otherwise like bract. Calyx cup-like, winged, light green with pinkish wings, 6–8 × 4 mm, glabrous, accrescent in fruits; lobes 5, basally united, ovate-triangular, 4–5 × 3 mm, glabrous, shortly acuminate apically, entire marginally. Corolla greenish-yellow, tubular, 10–13 × 4 mm, 3.5–4.5 mm diam., glabrous; lobes 5, 1 × 0.5 mm, ovate-linear. Stamens 10, encircling the pistil, distinct, 8–8.5 mm long; filaments slightly adnate to ovary disc, ca. 1 mm long, greenish-white, glabrous, spatulate, basally dilated; anthers 2-lobed, 7–7.5 mm long incl. tubules 4–5 mm long, granular with a minute tail. Pistil ca. 12 mm long; ovary syncarpous, 5-locular, ca. 4 × 3.5 mm, glabrous; ovules several in each locule on axile placentation; style slender, 8 mm long with 3–4 longitudinal ridges, glabrous; stigma simple, truncate apically. Fruit a berry, ovoid, 12–16 × 10–12 mm, light green (immature) to white (mature), glabrous, with an accrescent, winged calyx. Seeds numerous, ca. 1 mm long, obconical, scarious.

**Distribution.** Endemic to the eastern Himalaya of India (Sikkim and Darjeeling), eastern Nepal, and eastern Bhutan (Mongar and Deothang districts; fide Long and Rae 1991: 402).

**Habitat.** This species is extremely rare and threatened in subtropical-temperate forests at an altitude of about 2300–2650 m, associated with *Gaultheria stapfiana* Airy Shaw, *Rhododendron* spp., and *Vaccinium retusum* (Griff.) C.B. Clarke of Ericaceae as well as with *Quercus* spp. (Fagaceae).

**Flowering.** April–early September; December. **Fruiting.** July–August; December–January.



Figure 1. Lectotype of *Pentapterygium sikkimense* W.W. Sm. (K).



Figure 2. Isolectotype of *Pentapterygium sikkimense* W W. Sm

Figure 3. Epitype of *Pentapterygium sikkimense* W.W. Sm.

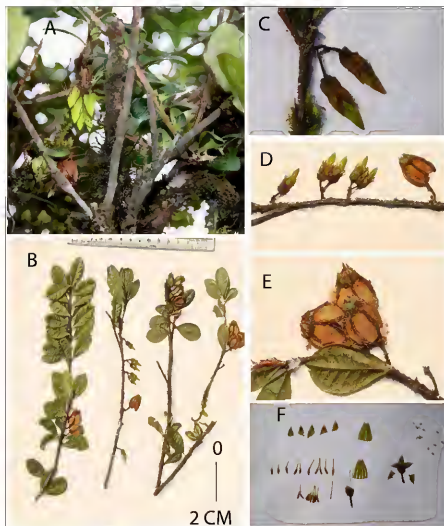


Figure 4. *Agapetes smithiana* Sleumer var. *smithiana*. A. Habit. B. Flowering and fruiting twigs. C-D. Inflorescence. E. Fruits. F. Floral parts. All from S. Panda 81 (CAL), as also shown in Fig. 3.

Additional specimens examined: **INDIA Sikkim:** Chutrey to Uttarey, 18 May 2002, *P. Singh* 24981 (BSHC fl buds), Damthang, 7000–8000 ft elev, Feb 2004, *A.K. Sahu* 26669 (BSHC fl) **Darjeeling:** below Tonglu at Dilpa, 8300 ft elev, 2 Apr 1975, *D. Chamberlain* 49 (DD: fl).

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## LECTOTYPIFICATION OF *MAXIMILIANA TRIPHYLLA* S.F. BLAKE (BIXACEAE)

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### ABSTRACT

The specimen originally designated as type of *Maximiliana triphylla* S.F. Blake is a single sheet composed of two syntypes collected on different dates. These syntypes belong to two different families of plant and the one that consists of reproductive material is selected here as the lectotype of *M. triphylla* in order to fix the name as Bixaceae.

**KEY WORDS:** lectotypification, *Maximiliana*, *Cochlospermum*, Bixaceae

When Blake (1921) revised the American species of *Maximiliana* Mart. ex Schrank (1819), nom. rej. (= *Cochlospermum* Kunth (1822), nom. cons.) (Bixaceae) he described and illustrated *M. triphylla* S.F. Blake from a single specimen in the U.S. National Herbarium (US). This specimen (Fig. 1), however, consists of two collections made by Henri Pittier on separate dates at or near the same locality in north-central Venezuela. Flower buds, flowers, and an inflorescence stalk were collected by Pittier in April and leaves in July 1920, and these separate collections were combined and distributed as Pittier 8930. No species of *Maximiliana* (= *Cochlospermum*) had the combination of characters seen on this specimen (i.e., trifoliolate leaves and anthers opening by a single terminal pore) and as a consequence Blake (1921) not only described *M. triphylla* but also noted that this new species upset the subgeneric classification of *Cochlospermum* proposed by Planchon (1847).

Poppendieck (1980), who revised *Cochlospermum* worldwide, concluded that the sole specimen cited by Blake when he described *Maximiliana triphylla* was a mixture of two elements: flowers of *C. vitifolium* (Willd.) Spreng. and leaves of an unknown family of plant. Although Poppendieck (1980, 1981) associated the name *M. triphylla* with *C. vitifolium*, he failed to typify *M. triphylla* on the Bixaceae element since he applied the word type to the sheet and not to the reproductive material on that sheet. In fact, Poppendieck (1980: 218, note 1) explicitly stated in his revision that lectotypes were designated for accepted names only. Examination of the type in the U.S. National Herbarium confirms that the reproductive material is *C. vitifolium* and that the leaves are *Pseudobombax septenatum* (Jacq.) Dugand (Malvaceae). The leaves on the type have 3–5 leaflets (not 3 as stated and illustrated by Blake) and these leaflets lack abscission zones at the base of their petiolules, an apomorphy peculiar to *Pseudobombax* Dugand and one that the artist who illustrated Blake's paper captured well (Blake, 1921, fig. 1a). Not surprisingly, *P. septenatum* also flowers when leafless and it is easy to imagine Pittier inadvertently collecting the leaves of this species thinking he had the leaves of the other. Interestingly, Pittier does not appear to have attempted to identify his specimen, as the species name and word "Type" on the label of the type specimen (as well as the collection number and year) are in Blake's hand. A duplicate specimen deposited in NY has a similar discordant mixture of floral and vegetative elements.





Figure 1. Lectotype of *Maximiliana triphylla* S.F. Blake (H. Pittier 8930, US-flower buds, flowers, and inflorescence stalk only)

In order to fix the name published by Blake as a species of Bixaceae rather than Malvaceae, the following lectotype is proposed:

**Maximiliana triphylla** S.F. Blake, J. Wash. Acad. Sci. 11(6): 129, fig. 1b–e. 19 Mar 1921. *Cochlospermum triphyllum* (S.F. Blake) Pittier, Man. Pl. Usual. Venez. 141. 1926. **TYPE:** Venezuela. Carabobo: In hedges, Valencia and vicinity, Apr 1920 (fl), H. Pittier 8930 (lectotype, designated here: US-flower buds, flowers, and inflorescence stalk only! [bar code 1065095]; isolectotype: NY-flower buds and flowers only, as image! [bar code 00095010]) [= *Cochlospermum vitifolium* (Willd.) Spreng.].

The *Code* (McNeill et al., 2006; see Art. 8.2) now defines a specimen for the purposes of typification as “a gathering ... made at one time,” which effectively proscribes the former and ill-advised practice of combining collections made on different dates. Certainly what tempted Pittier was the desire to make a “complete” specimen by associating leaves with the flowers of a species that was leafless when flowering, but as has been shown here we would have been better served if his two collections had been numbered and mounted separately.

#### ACKNOWLEDGEMENT

Ingrid Pol-Yin Lin (US) provided the photograph of the lectotype specimen.

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## **CHAMAESYCE CORDIFOLIA (EUPHORBIACEAE) NEW TO OKLAHOMA**

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### **ABSTRACT**

*Chamaesyce cordifolia* (Euphorbiaceae) is reported as new to the state of Oklahoma. It is now known there from two collections, apparently at the northwestern edge of the distribution of the species.

**KEY WORDS:** Euphorbiaceae, *Chamaesyce*, Atoka County, Pushmataha County, Oklahoma, USA.

*Chamaesyce* [*Euphorbia*] *cordifolia* (Elliott) Small (Euphorbiaceae; heartleaf sandmat) is a prostrate annual with stems to 65 cm long, entire leaves, and styles that are bifid to the base (Diggs et al 1999) (Figs. 1, 2). The species occurs in loose sandy soils in the southeastern coastal plain from North Carolina south to Florida and west to Arkansas and Texas. It was not included in the flora of Oklahoma by Waterfall (1966) or Taylor and Taylor (1994), and it is not cited as part of the Oklahoma flora in USDA, NRCS (2012) or the Oklahoma Vascular Plants Database (2012). Based upon the specimens cited below, *C. cordifolia* is here reported as new to Oklahoma.

Voucher specimens: USA. **Oklahoma.** Atoka Co.: Boehler; 0.5 mi W of Boehler, 13 Aug 1976, L.K. Magrath, J. Taylor, & A. Lavalley 9476 (OKL, Fig. 1). Pushmataha Co.: 0.1 mi. W of Jct. of Co Rd 1940 (N Hall Rd) and Co Rd 4100 on Co Rd 1940, N side of Co Rd 1940 (34° 12' 1.42" N, 95° 43' 47.23" W), 2 Jun 2007; J. Singhurst 19083 (BAYLU).

The area of the Magrath et al. collection from 1976 is the Boehler Seeps and Sandhills Preserve owned by the Oklahoma Chapter of the Nature Conservancy. The Taylors obviously knew it was there but failed to get it into the last edition of Taylor and Taylor (1994). It might have been because the specimen itself went missing; it just recently turned up in a box received (within the past two years) from Larry Magrath's herbarium in Chickasha, Oklahoma, that was sent as a gift to the BEB Herbarium.

There is, however, another undocumented citation of *Chamaesyce cordifolia* in Oklahoma. Bridges et al. (1985), in an inventory of the vegetation of the Boehler Seeps and Sandhills Preserve in Atoka County, mentioned observing a population of *C. cordifolia* there. Steve Orzell provided the following comments extracted from their (Bridges & Orzell) collection records: "We were in OK collecting May 27, 1985 thru June 1st with John & Connie Taylor but NO [upper case by Orzell]

collections of *Chamaesyce cordifolia*. We were also collecting in OK in March 25, 1987... but no specimens of *Chamaesyce*....”

The cited Oklahoma occurrences apparently represent the northwestern edge of the distribution of the species. *Chamaesyce cordifolia* is documented in Miller Co., Arkansas (Witsell 07-0597 & 11-0443 (ANHC)), which is approximately 225 km to the southeast. In Texas, the nearest known occurrences are from Bivins, Cass Co. (Correll 26414, LL), about 200 km to the southeast, and Roanoke, Denton Co. (Lundell & Lundell 9547, LL), about 185 km to southwest.

In Atoka County, *Chamaesyce cordifolia* occurs in open areas in upland oak woods over Atoka sand. Specific associates include *Paronychia drummondii*, *Polygonella americana*, and *Dalea phleoides* var. *microphylla*. In Pushmataha County, *C. cordifolia* occurs in Post Oak Savanna xeric sandhill openings over Atoka sand. The areas are dominated by *Aristida desmantha*, *Cnidoscolus texanus*, *Croptilon divaricatum*, *Eriogonum multiflorum*, *Helianthemum georgianum*, *Matelea cynanchoides*, *Paronychia drummondii*, and *Penstemon murrayanus*. The *Chamaesyce* presumably will be ranked S1 by the Oklahoma Natural Heritage Inventory, indicating that it is “critically imperiled in the state because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the jurisdiction” (Oklahoma Natural Heritage Inventor 2012, NatureServe Explorer 2012).



Figure 1. *Chamaesyce cordifolia* (Magrath et al. 9476, OKL, see Voucher specimens), the first known collection of the species from Oklahoma. Inset shows scale.



Figure 2. *Chamaesyce cordifolia* in natural habitat in Aransas Co., Texas (photo by William R. Carr).

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## A NOMENCLATURAL SUMMARY OF THE PLANT AND ANIMAL NAMES BASED ON IMAGES IN MARK CATESBY'S *NATURAL HISTORY* (1729–1747)

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### ABSTRACT

The English naturalist Mark Catesby is best known for his two volume work entitled *Natural History of Carolina, Florida and the Bahama Islands* wherein he described and illustrated numerous plants and animals found mainly in the eastern North American English colonies of Virginia, South Carolina, Georgia, and the Bahamas. This monumental work, published in parts from 1729 until 1747, became an important source of new species described by the Swedish natural Carl Linnaeus in the 1750s and 1760s. The summary presented here attempts to account for all instances where a new taxon was proposed wherein a reference was made by the author of the name to a published plate in Catesby. The nomenclatural status of each image is evaluated with a footnote providing a reference to both where the name was proposed and who, in the case of plants, designated a lectotype. Images are not considered to be types under the rules governing zoological nomenclature. No attempt is made here to account for the subsequent neotypification of names established under that code.

**KEY WORDS:** Mark Catesby, nomenclature, typification, North America

The English naturalist and artist, Mark Catesby, was born on 24 March 1683 (Julian) in the village of the Castle Hedingham, Essex, as the fifth son of John Catesby, a lawyer, and Elizabeth Jekyll, the daughter of a prosperous family of lawyers. When his father died in 1805, leaving Mark with a small inheritance and decidedly limited prospects in England, he sailed for Northumberland, Virginia, to live with his sister, Elizabeth Cocke, and her husband, Dr. William Cocke. His travels in the Virginia colony were limited but fruitful as it was here that he began to gather specimens of the local flora and fauna, sketching each in varying degrees of exactness. While there Catesby became acquainted with a young clerk named John Clayton who would play a future role in Catesby's life and was destined to become a foremost source of Virginia plants prior to 1753 for Swedish naturalist Carl Linnaeus.

When he returned to England in 1719, Catesby gave his collection of pressed, dried flowering specimens to Samuel Dale, and via this gift—and a talent in natural history—Catesby was nominated to the Royal Society which, in 1721, granted him membership. The following year Catesby returned to the New World, arriving in South Carolina—now under the formal sponsorship of the Royal Society, and its informal off-shoot, the Temple House Coffee Club, and thus he had the financial support of the likes of Hans Sloane (secretary of the Society), William Sherard (Oxford University), and Charles Dubois (of the East India Company). Most importantly he had the support of Governor Francis Nicholson, long a supporter of naturalists in American colonies, starting with Hugh Jones in Maryland in the late 1690s.

With the Governor's allowance of 20£ a year, Catesby set to the task of collecting and illustrating the curious animals of the Carolina colony. He made detailed sketches of both plants and animals and may have learned to watercolor in the process, while collecting numerous specimens of flowering plants, conifers, and ferns, marine algae, and a multitude of animals from mammals, birds, and fishes to tiny insects and beetles. He even gathered some marine organisms, but most importantly he concentrated on the birds. This time he traveled widely, venturing into coastal



Georgia, but not Florida, and while he visited Cuba in 1717, in 1825 Catesby went to the Bahamas as the guest of Governor Charles Phinney and spent nine months there collecting and drawing its natural history. In 1726, Mark Catesby returned to England with the goal of composing a book on the natural history he observed.

A proposal to the Royal Society (Catesby 1728) resulted in a number of members subscribing to *Natural history of Carolina, Florida and the Bahama Islands* with the first set of twenty plates issued in May of 1729. It was not an easy task even though, eventually, there were 154 subscribers. Catesby learned to watercolor and he engraved copper plates from Joseph Goupy; Catesby was a good but not all that talented an illustrator. He wrote the text and coined a number of new scientific names for his novelties. The first volume was published in parts from 1729 into 1732 with a total of 100 plates, most devoted to birds. With the completion of the first volume, Catesby was elected a Fellow of the Society in 1733 and thereafter his name was associated with those famed initials “F.R.S.”

The second volume was more slowly and painfully produced. Catesby realized that he needed more material and called upon John Clayton to send him plant specimens and especially seeds so that he could more accurately illustrate his plants, which became a more dominant feature in this volume. Even with a larger number of subscribers and the help of famed botanical illustrator Georg Ehret, there was rarely enough cash on hand to do the work and feed his young family. Complicating matters even more was Catesby's gradually failing health. Forced to work at various nurseries and at a few, select estates, at least Catesby had access to some of his own introductions in England. With Clayton augmenting Catesby's understanding of several species, and Catesby own access to the introductions of others—most notably those of John Bartram—his knowledge of the flora grew considerably, meaning that some new errors were introduced into the scientific literature resulting in confusion that has persisted to the present. In addition to plants, the last volume was dominated by mammals, insects, beetles, and marine organisms, with the illustrations usually far better than those of the first volume.

The last years of Catesby's life were fraught with illness and frustration in producing an appendix of twenty images sometimes sold without text in 1747, four years after completion of the second 100 plates. He died sometime in mid-December of 1749 and was buried on the 23<sup>rd</sup> of that year.

Catesby's Virginia plants were given by Samuel Dale's widow to the Apothecary Society of London and were “lost” until rediscovered in 1983. His later collections from South Carolina, Georgia, and the Bahamas were obtained by Hans Sloane and are now in the Natural History Museum in London. Other samples were sent to Johann Jacob Dillenius and thus are in the Sherard and Dubois herbaria at the University of Oxford. A limited number of extant herbarium specimens are in Leiden, Paris, and elsewhere in Europe. New editions of Catesby's *Natural history* soon appeared. The Seligmann edition was published in German in 1749-1750, with Seligmann re-etching the birds. A French version of this work was published from 1768 until 1776 (see also Seligmann 1770-1773). In 1750, Eisenberger and Lichtensteiger published another new edition of the second volume. This was reprinted in 1777.

Far more significant was the second edition of Catesby's *Natural history* revised and reissued by George Edwards. While Catesby hand-colored each of his plates, those of the second edition were colored by a variety of individuals, with some copies stunning and others rather mundane. Abbreviated volumes were published as *Hortus britanno-americanus* (1763) and *Hortus europae americanus* (1767). A third edition, exquisitely colored, was published by Benjamin White in 1771. This edition contains an index with Linnaean names for all plants and animals. Several new names

were proposed by Edwards, and while several of his plant names are in use or at least known, those of animals have been forgotten and are now suppressed because there were not in common use for a century or more.

The most recent edition is an abbreviated version issued in 1974 by Beehive Press with an introduction by George Frick and identification notes by Joseph Ewan. Catesby's birds were recently evaluated by Feduccia in 1985 while the plants subsequently were reviewed by Howard and Staples (1983) and Wilbur (1990). In 2009, Reveal published a detailed review of Catesby's published plates and his original drawings (now at the Royal Library at Windsor Castle—see McBurney 1997), and with the help of many others, was able to identify essentially all plants (save one) and animals (except a few insects and one marine organism). Significantly, as a result of this review, the blue-winged warblers, first found in 1768, was given its own name in 2009 as zoologists had used the same Linnaean epithet taken from Catesby to apply to two different birds in different genera.

The best review of Catesby's life remains Frick and Stearns (1961); the book by Meyer et al. (1998) is useful. The 1996 Aleo facsimile of the original Catesby watercolors is elegant but expensive. Online copies of Catesby are also available (see p. 30). Information on the published Catesby plates used as types of plants named by Linnaeus is summarized by Jarvis (2007) and by Reveal (2009). This summary is presented as part of the tercentennial celebration of Mark Catesby's arrival in Virginia.

#### Summary of organisms illustrated by Mark Catesby (1729–1747) with comments on their typification

Below is a summary table of the identity of the organisms illustrated by Mark Catesby (1729–1747). When possible, published images in Catesby's *Natural History* were compared with the original watercolors to update determinations of the species; this presentation updates that by Ewan (1974), Howard and Staples (1983), Wilbur (1990), and Reveal (2009). The summary is arranged by the Catesby volume and plate number. Where applicable, scientific names are followed by an indication of the organism's location on the image (right, left, above, below, foreground, background, etc.). Names are followed by the Royal Library accession number (RL, Windsor Castle) and the sheet numbers in the facsimile of watercolors reproduced by Aleo Historical Edition (AHE). In its complete set, the AHE facsimile is divided into three volumes consisting of volume 1 (plates 1–100), volume 2 (plates 101–200), and volume 3 (plates 201–263). Plant names are in bold type to distinguish them from other organisms. Images cited in the original descriptions of new taxa are indicated by an asterisk. Footnotes detail aspects of the type information starting on page 14.

Catesby –1729–	Scientific Name & Common Name	RL	AHE
1: t. 1.	<i>Haliaeetus leucocephalus</i> (Linnaeus, 1766) – bald eagle <sup>1</sup>	24814	1 *
	<i>Mugil cephalus</i> Linnaeus, 1758 (probably) – gray mullet	24814	1
1: t. 2.	<i>Pandion haliaetus</i> (Linnaeus, 1758) – osprey <sup>2</sup>	24815	186 *
1: t. 2.	<i>Mugil cephalus</i> Linnaeus, 1758 (probably) – gray mullet	24815	186
1: t. 3.	<i>Falco columbarius</i> Linnaeus, 1758 – merlin <sup>3</sup>	24816	161 *
1: t. 4.	<i>Elanoides forficatus</i> (Linnaeus, 1758) – swallow-tail kite <sup>4</sup>	24817	21 *
1: t. 5.	<i>Falco sparverius</i> Linnaeus, 1758 – American kestrel <sup>5</sup>	24818	61 *
1: t. 6.	<i>Cathartes aura</i> (Linnaeus, 1758) – turkey vulture <sup>6</sup>	24819	162 *
1: t. 7.	<i>Megascops asio</i> (Linnaeus, 1758) – eastern screech-owl <sup>7</sup>	24820	101 *
1: t. 8.	A composite of three birds: <i>Chordeiles minor</i> (J.R. Forster, 1771) – common nighthawk; <i>Caprimulgus carolinensis</i> J.F. Gmelin, 1789 – chuck's-will-widow; and <i>Caprimulgus vociferus</i> A. Wilson, 1812 – whip-poor-will <sup>8</sup>	24821	141 *

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Gryllotalpa gryllotalpa</i> (Linnaeus, 1758; right) – mole cricket <sup>9</sup>	24821	141 *
1: t. 9.	<i>Coccyzus americanus</i> (Linnaeus, 1758) – yellowbilled cuckoo <sup>10</sup>	24822	81 *
	<i>Castanea punila</i> (L.) Mill. – Allegany chinquapin <sup>11</sup>	24822	81 *
1: t. 10.	<i>Amazona</i> aff. <i>leucocephala</i> (Linnaeus, 1758) – Cuban parrot <sup>12</sup>	24823	226 *
	<i>Columbina elliptica</i> (Sw.) Brizicky & W.L. Stern – soldierwood	24823	226
1: t. 11.	<i>Conuropsis carolinensis</i> (Linnaeus, 1758) – Carolina parakeet <sup>13</sup>	24824	22 *
	<i>Taxodium distichum</i> (L.) L.C. Rich. – bald cypress <sup>14</sup>	24824	22 *
1: t. 12.	<i>Quiscalus quiscula</i> (Linnaeus, 1758) – common grackle <sup>15</sup>	24825	201 *
1: t. 13.	<i>Agelaius phoeniceus</i> (Linnaeus, 1766) – red-winged blackbird <sup>16</sup>	24826	142 *
	<i>Morella caroliniensis</i> (Mill.) Small – evergreen bayberry <sup>17</sup>	24826	142 *
1: t. 14.	<i>Dolichonyx oryzivorus</i> (Linnaeus, 1758) – bobolink <sup>18</sup>	24827	181 *
	<i>Oryza sativa</i> L. – rice <sup>19</sup>	24827	181 *
1: t. 15.	<i>Cyanocitta cristata</i> (Linnaeus, 1758) – bluejay <sup>20</sup>	24828	42 *
	<i>Smilax laurifolia</i> L. – laurel greenbrier <sup>21</sup>	24828	42 *
1: t. 16.	<i>Campephilus principalis</i> (Linnaeus, 1758) – ivory-billed woodpecker <sup>22</sup>	24829	82 *
	<i>Quercus phellos</i> L. – willow oak <sup>23</sup>	24829	82 *
1: t. 17.	<i>Dryocopus pileatus</i> (Linnaeus 1758) – piliated woodpecker <sup>24</sup>	24830	102 *
	<i>Quercus virginiana</i> Mill. – live oak <sup>25</sup>	24830	102 *
1: t. 18.	<i>Colaptes auratus</i> (Linnaeus, 1758) – northern flicker <sup>26</sup>	24831	121 *
	<i>Quercus michauxii</i> Nutt. – swamp chestnut oak <sup>27</sup>	24831	121 *
1: t. 19.	<i>Melanerpes carolinus</i> (Linnaeus, 1758; above, right) – red-bellied woodpecker <sup>28</sup>	24832	216 *
	<i>Picoides villosus</i> (Linnaeus, 1766; below, left) – hairy woodpecker <sup>29</sup>	24832	216 *
	<i>Quercus marilandica</i> Münchh. – blackjack oak <sup>30</sup>	24832	216 *
1: t. 20.	<i>Melanerpes erythrocephalus</i> (Linnaeus, 1758) – red-headed woodpecker <sup>31</sup>	24833	182 *
	<i>Quercus nigra</i> L. (above) – water oak <sup>32</sup>	24833	182 *
	<i>Mitchella repens</i> L. (below) – partridgeberry <sup>33</sup>	24833	182 *
–1730–			
1: t. 21.	<i>Sphyrapicus varius</i> (Linnaeus, 1766; above, right) – yellow-bellied sapsucker <sup>34</sup>	24834	183 *
	<i>Picoides pubescens</i> (Linnaeus, 1766; below, left) – downy woodpecker <sup>35</sup>	24834	183 *
	<i>Quercus alba</i> L. (left; acorn on right) – white oak <sup>36</sup>	24834	183 *
	<i>Quercus falcata</i> Michx. (right) – southern red oak <sup>37</sup>	24834	183
1: t. 22.	<i>Sitta pusilla</i> (Latham, 1790; above) – brown-headed nuthatch <sup>38</sup>	24835	196 *
	<i>Sitta carolinensis</i> (Latham, 1790) – white-breasted nuthatch <sup>39</sup>	24835	196 *
	<i>Quercus incana</i> W. Bartram – bluejack oak <sup>40</sup>	24835	196 *
1: t. 23.	<i>Ectopistes migratorius</i> (Linnaeus, 1758) – passenger pigeon <sup>41</sup>	24836	62 *
	<i>Quercus laevis</i> Walter – turkey oak <sup>42</sup>	24836	62 *
1: t. 24.	<i>Zenaida macroura</i> (Linnaeus, 1758) – mourning dove <sup>43</sup>	24837	202 *
	<i>Podophyllum peltatum</i> L. – mayapple <sup>44</sup>	24837	202 *
1: t. 25.	<i>Patagioenas leucocephala</i> (Linnaeus, 1758) – whitecrowned pigeon <sup>45</sup>	24838	163 *
	<i>Chrysobalanus icaco</i> L. – icaco coco plum	24838	163
1: t. 26.	<i>Columbina passerina</i> (Linnaeus, 1758) – common ground-dove (24839b) <sup>46</sup>	24839	232 *

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Columbina passerina</i> (Linnaeus, 1758) – common ground-dove (24839a)	24839	231
	<i>Zanthoxylum clava-herculis</i> L. – Hercules' club (24839a) <sup>47</sup>	24839	231 *
	<i>Anacardium occidentale</i> L. (fruit) – cashew (24839b)	24839	231
1: t. 27.	<i>Mimus polyglottos</i> (Linnaeus, 1758) – northern mockingbird <sup>48</sup>	24840	143 *
	<i>Cornus florida</i> L. – flowering dogwood <sup>49</sup>	24840	143 *
1: t. 28.	<i>Toxostoma rufum</i> (Linnaeus, 1758) – brown thrasher <sup>50</sup>	24841	23 *
	<i>Prunus virginiana</i> L. – choke cherry <sup>51</sup>	24841	23 *
1: t. 29.	<i>Turdus migratorius</i> Linnaeus, 1766 – American robin <sup>52</sup>	24842	217 *
	<i>Aristolochia serpentaria</i> L. – Virginia dutchmanspipe <sup>53</sup>	24842	217 *
1: t. 30.	<i>Turdus plumbeus</i> Linnaeus, 1758 – red-legged thrush <sup>54</sup>	24843	184 *
	<i>Bursera simaruba</i> (L.) Sarg. – gumbo limbo <sup>55</sup>	24843	184 *
1: t. 31.	<i>Catharus guttatus</i> (Pallas, 1811) – hermit thrush (doubtful)	24844	218
	<i>Ilex cassine</i> L. – dahoon <sup>56</sup>	24844	218 *
1: t. 32.	<i>Eremophila alpestris</i> (Linnaeus, 1758) – horned lark <sup>57</sup>	24845	203 *
	<i>Anthus rubescens</i> (Tunstall, 1771; below) – American pipit – not published	24845	203
	<i>Uniola paniculata</i> L. – sea-oats – not published	—	—
1: t. 33.	<i>Sturnella magna</i> (Linnaeus, 1858) – eastern meadowlark <sup>58</sup>	24846	164 *
	<i>Hypoxis hirsuta</i> (L.) Coville – common goldstar	25892	44
1: t. 34.	<i>Pipilo erythrophthalmus</i> (Linnaeus, 1758; above) – eastern towhee <sup>59</sup>	24847	204 *
	<i>Molothrus ater</i> (Boddaert, 1783; below) – brown-headed cowbird	24847	204
	<i>Populus heterophylla</i> L. – swamp cottonwood <sup>60</sup>	24847	204 *
1: t. 35.	<i>Passerina cyanea</i> (Linnaeus, 1766), probably – indigo bunting	24848	205
	<i>Dendroica dominica</i> (Linnaeus, 1766; below) – not published	24848	205
	<i>Hypercompe scribonta</i> (Stoll, 1790) – giant leopard moth	26077	94
	Unidentified wasp (lower left) – not published	24848	205
	<i>Ipomoea sagittata</i> Poit. – saltmarsh morningglory	24849	36
1: t. 36.	<i>Junco hyemalis</i> (Linnaeus, 1758) – dark-eyed junco <sup>61</sup>	24855	242 *
	<i>Monotropa uniflora</i> L. (left) – one-flower Indian-pipe <sup>62</sup>	24850	241 *
	<i>Geoglossum glabrum</i> Pers. ex Fr. (right) – black adder tongue fungus	24850	241
1: t. 37.	<i>Tiaris bicolor</i> (Linnaeus, 1766) – black-faced grassquit <sup>63</sup>	24851	197 *
	<i>Tabebuia bahamensis</i> (Northr.) Britton – white dwarf tabebuia <sup>64</sup>	24851	197 *
1: t. 38.	<i>Cardinalis cardinalis</i> (Linnaeus 1758) – northern cardinal <sup>65</sup>	24852	122 *
	<i>Carya tomentosa</i> (Lam.) Nutt. (branch) – mockernut hickory <sup>66</sup>	24852	122 *
	<i>Carya glabra</i> (Mill.) Sweet (solitary fruit; below right) – pignut hickory	24852	122
1: t. 39.	<i>Passerina caerulea</i> (Linnaeus, 1758) – blue grosbeak <sup>67</sup>	24853	63 *
	<i>Magnolia virginiana</i> L. – sweetbay <sup>68</sup>	24853	63 *
1: t. 40.	<i>Loxigilla violacea</i> (Linnaeus, 1758) – greater Antillean bullfinch <sup>69</sup>	24854	123 *
	<i>Metopium toxiferum</i> (L.) Krug & Urb. – Florida poisonwood <sup>70</sup>	24854	123 *
1: t. 41.	<i>Carpodacus purpureus</i> (J.F. Gmelin, 1789) – purple finch <sup>71</sup>	24855	242 *
	<i>Nyssa sylvatica</i> Marshall – black tupelo <sup>72</sup>	24855	242 *
1: t. 42.	<i>Spindalis zena</i> (Linnaeus, 1758) – stripe-headed tanager <sup>73</sup>	24856	1 *
	<i>Jacaranda caerulea</i> (L.) J. St.-Hil. – cancer tree <sup>74</sup>	24856	1 *
1: t. 43.	<i>Carduelis tristis</i> (Linnaeus, 1758) – American goldfinch <sup>75</sup>	24857	64 *
	<i>Gleditsia aquatica</i> Marshall – water honeylocust <sup>76</sup>	24857	64 *
1: t. 44.	<i>Passerina ciris</i> (Linnaeus, 1758) – painted bunting <sup>77</sup>	25875	43

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	<i>Passerina cyanea</i> (Linnaeus, 1766) – indigo bunting – not published	25875	43
	<i>Gordonia lasianthus</i> (L.) J. Ellis – loblolly bay <sup>78</sup>	—	— *
	<i>Magnolia virginiana</i> L. – sweetbay – not published	25875	43
1: t. 45.	<i>Passerina cyanea</i> (Linnaeus, 1766) – indigo bunting <sup>79</sup>	25877	243 *
	<i>Trillium catesbaei</i> Elliott – bashful wakerobin <sup>80</sup>	25876	176 *
1: t. 46.	<i>Bombycilla cedrorum</i> Vieillot, 1808 – cedar waxwing <sup>81</sup>	25878	244 *
	<i>Calycanthus floridus</i> L. – eastern sweetshrub <sup>82</sup>	25877	243 *
	<i>Magnolia virginiana</i> L. – sweetbay – not published	25878	244
1: t. 47.	<i>Sialia sialis</i> (Linnaeus, 1758) – eastern bluebird <sup>83</sup>	25879	83 *
	<i>Smilax pumila</i> Walter – sarsaparilla vine <sup>84</sup>	25879	83 *
1: t. 48.	<i>Icterus galbula</i> (Linnaeus, 1758) – Baltimore oriole <sup>85</sup>	25880	116 *
	<i>Liriodendron tulipifera</i> L. – tulip poplar <sup>86</sup>	25880	116 *
1: t. 49.	<i>Icterus spurius</i> (Linnaeus, 1766) – orchard oriole <sup>87</sup>	25881	245 *
	<i>Catalpa bignonioides</i> Walter – southern catalpa <sup>88</sup>	25881	245 *
1: t. 50.	<i>Icteria virens</i> (Linnaeus, 1758) – yellow-breasted chat <sup>89</sup>	25882	246 *
	<i>Trillium maculatum</i> Raf. – spotted wakerobin <sup>90</sup>	25883	247 *
	<i>Acer rubrum</i> L. var. <i>trilobum</i> Torr. & A. Gray ex K. Koch – Carolina red maple – not published	25882	246
1: t. 51.	<i>Progne subis</i> (Linnaeus, 1758) – purple martin <sup>91</sup>	25884	248 *
	<i>Coccyus carolinus</i> (L.) DC. – Carolina coralbead <sup>92</sup>	—	— *
1: t. 52.	<i>Myiarchus crinitus</i> (Linnaeus, 1758) – great crested flycatcher <sup>93</sup>	25886	250 *
	<i>Smilax tannoides</i> L. – bristly greenbrier <sup>94</sup>	25886	250 *
1: t. 53.	<i>Sayornis phoebe</i> (Latham, 1790) – eastern phoebe	25886	250
	<i>Gelsemium sempervirens</i> (L.) J. St-Hil. – Carolina jessamine <sup>95</sup>	25887	251 *
1: t. 54.	<i>Contopus virens</i> (Linnaeus, 1766; above) – eastern wood-pewee	25888	252
	<i>Vireo olivaceus</i> (Linnaeus, 1766; below) – red-eyed vireo <sup>96</sup>	25888	252 *
	<i>Symplocos tinctoria</i> (L.) L'Her. – common sweetleaf <sup>97</sup>	25888	252 *
1: t. 55.	<i>Tyrannus tyrannus</i> (Linnaeus, 1758) – eastern kingbird <sup>98</sup>	25890	254 *
	Unidentified wasp or bee	—	—
	<i>Sassafras albidum</i> (Nutt.) Nees – sassafras <sup>99</sup>	25890	254 *
	<i>Sassafras albidum</i> (Nutt.) Nees – sassafras – not published	25889	253
1: t. 56.	<i>Piranga rubra</i> (Linnaeus, 1758) – summer tanager <sup>100</sup>	25891	255 *
	<i>Platanus occidentalis</i> L. – American sycamore <sup>101</sup>	25891	255 *
1: t. 57.	<i>Baeolophus bicolor</i> (Linnaeus, 1766) – tufted titmouse <sup>102</sup>	25892	44 *
	<i>Rhododendron viscosum</i> (L.) Torr. – swamp azalea <sup>103</sup>	25892	44 *
1: t. 58.	<i>Dendroica coronata</i> (Linnaeus, 1766) – yellow-rumped warbler <sup>104</sup>	25893	256 *
	<i>Cleistes divaricata</i> (L.) Ames – rosebud orchid <sup>105</sup>	25893	256 *
	<i>Echites umbellatus</i> Jacq. (below) – devil's potato	—	—
1: t. 59.	<i>Coereba flaveola bahamensis</i> (Reichenbach, 1853) – Bahama bananaquit <sup>106</sup>	25894	117 *
	<i>Casasia elusifolia</i> (Jacq.) Urb. – seven-year-apple <sup>107</sup>	25894	117 *
1: t. 60.	<i>Wilsonia citrina</i> (Boddaert, 1783) – hooded warbler	25895	257
	<i>Nyssa aquatica</i> L. – water tupelo <sup>108</sup>	25895	257 *
–1731–			
1: t. 61.	<i>Dendroica pinus</i> (Linnaeus, 1758) – pine warbler <sup>109</sup>	25897	2 *
	<i>Osmanthus americanus</i> (L.) Benth. & Hook.f. ex A. Gray – American devilwood	25896	198
1: t. 62.	<i>Dendroica dominica</i> (Linnaeus, 1766) – yellow-throated warbler	25897	2

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Acer rubrum</i> L. – red maple <sup>110</sup>	25897	2 *
1: t. 63.	<i>Dendroica petechia</i> (Linnaeus, 1766), <i>sen. lat.</i> – yellow warbler	25898	258
	<i>Persea borbonia</i> (L.) Spreng. – redbay <sup>111</sup>	25898	258 *
1: t. 64.	<i>Parula americana</i> (Linnaeus, 1758) – northern parula <sup>112</sup>	25899	259 *
	<i>Halesia tetraptera</i> J. Ellis – mountain silverbell <sup>113</sup>	25899	259 *
1: t. 65.	<i>Archilochus colubris</i> (Linnaeus, 1758) – rubythroated hummingbird <sup>114</sup>	25900	236 *
	<i>Campsis radicans</i> (L.) Seem. ex Bureau – trumpet creeper <sup>115</sup>	25900	236 *
1: t. 66.	<i>Dumetella carolinensis</i> (Linnaeus, 1766) – gray catbird <sup>116</sup>	25901	237 *
	Unidentified insect (left) – not published	25901	237
	<i>Clethra alnifolia</i> L. – coastal sweetpepperbush <sup>117</sup>	—	— *
1: t. 67.	<i>Setophaga ruticilla</i> (Linnaeus, 1758) – American redstart <sup>118</sup>	25902	84 *
	<i>Juglans nigra</i> L. – black walnut <sup>119</sup>	25902	84 *
1: t. 68.	<i>Melopyrrha nigra</i> (Linnaeus, 1758) – Cuban bullfinch <sup>120</sup>	25903	238 *
	<i>Chionanthus virginicus</i> L. – fringetree <sup>121</sup>	25903	238 *
1: t. 69.	<i>Megaceryle alcyon</i> (Linnaeus, 1758) – belted kingfisher <sup>122</sup>	25904	206 *
	Unidentified – non-descript fish	25904	206
	<i>Morelia cerifera</i> (L.) Small – wax myrtle <sup>123</sup>	—	— *
1: t. 70.	<i>Porzana carolina</i> (Linnaeus, 1758) – sora (25905b) <sup>124</sup>	25905	260 *
	<i>Gentiana catesbaei</i> Walter – Elliott's gentian (25905a) <sup>125</sup>	25905	261 *
	Unidentified – bryophyte (lower left)	—	—
	<i>Nyssa sylvatica</i> Marshall – black tupelo – not published	25905	261
1: t. 71.	<i>Charadrius vociferus</i> Linnaeus, 1758 – killdeer <sup>126</sup>	25906	233 *
	<i>Oxydendrum arboreum</i> (L.) DC. – sourwood <sup>127</sup>	25906	233 *
1: t. 72.	<i>Arenaria interpres</i> (Linnaeus, 1758) – ruddy turnstone	25907	234
	<i>Salmea petrochioides</i> Griseb. – shanks	25907	234
1: t. 73.	<i>Phoenicopterus ruber</i> Linnaeus, 1758 (foreground) – American flamingo <sup>128</sup>	25908	103 *
	<i>Plexaurella dichotoma</i> (Esper, 1791) (background) – double-forked plexaurella	25908	103
1: t. 74.	<i>Phoenicopterus ruber</i> Linnaeus, 1758 (foreground) – American flamingo <sup>129</sup>	25909	165 *
	<i>Plexaura flexuosa</i> Lamouroux, 1821 (background) – bent sea-rod	25909	165
1: t. 75.	<i>Grus americana</i> (Linnaeus, 1758) – whooping crane <sup>130</sup>	25910	221 *
	<i>Reynosa septentrionalis</i> Urb. – darlingplum	—	—
1: t. 76.	<i>Egretta caerulea</i> (Linnaeus, 1758) – little blue heron <sup>131</sup>	25911	65 *
1: t. 77.	<i>Egretta caerulea</i> (Linnaeus, 1758) – little blue heron	—	—
	<i>Phymosia abutiloides</i> (L.) Desv. ex Ham. – Bahaman thymosa <sup>132</sup>	—	— *
1: t. 78.	<i>Botaurus lentiginosus</i> (Rackett, 1813) – American bittorn	25912	211
1: t. 79.	<i>Nyctanassa violacea</i> (Linnaeus, 1758) – yellowcrowned night-heron <sup>133</sup>	25913	227 *
	<i>Scaevola plumieri</i> (L.) Vahl – gullfeed <sup>134</sup>	25913	227 *
1: t. 80.	<i>Butorides virescens</i> (Linnaeus, 1758) – green heron <sup>135</sup>	25914	24 *
	<i>Fraxinus caroliniana</i> Mill. – Carolina ash <sup>136</sup>	25914	24 *
–1732–			
1: t. 81.	<i>Mycteria americana</i> Linnaeus, 1758 – wood stork <sup>137</sup>	25915	228 *
1: t. 82.	<i>Eudocimus albus</i> (Linnaeus, 1758) – white ibis <sup>138</sup>	25916	124 *
	<i>Orontium aquaticum</i> L. – goldenclub	25917	239
1: t. 83.	<i>Eudocimus albus</i> (Linnaeus, 1758) – white ibis <sup>139</sup>	25918	45 *

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Peltandra virginica</i> (L.) Raf. ex Schott – green arrow arum	—	—
1: t. 84.	<i>Eudocimus ruber</i> (Linnaeus, 1758) – scarlet ibis <sup>140</sup>	25919	3 *
1: t. 85.	<i>Haematopus palliatus</i> Temminck, 1820 – American oystercatcher <sup>141</sup>	25920	235 *
	<i>Avicennia germinans</i> (L.) L. – black mangrove	25920	235
1: t. 86.	<i>Morus bassanus</i> (Linnaeus, 1758) – northern gannet	25921	229
	<i>Laguncularia racemosa</i> (L.) C.F. Gaertn. – white mangrove	25921	229
1: t. 87.	<i>Sula leucogaster</i> (Boddaert, 1783) – brown booby <sup>142</sup>	25922	230 *
1: t. 88.	<i>Anous stolidus</i> (Linnaeus, 1758) – brown noddy <sup>143</sup>	25923	222 *
1: t. 89.	<i>Larus atricilla</i> Linnaeus, 1758 – laughing gull <sup>144</sup>	25924	207 *
1: t. 90.	<i>Rynchops niger</i> Linnaeus, 1758 – black skimmer <sup>145</sup>	25925	262 *
1: t. 91.	<i>Podilymbus podiceps</i> (Linnaeus, 1758) – pied-billed grebe <sup>146</sup>	25926	223 *
1: t. 92.	<i>Branta canadensis</i> (Linnaeus, 1758) – Canada goose <sup>147</sup>	25927	263 *
	<i>Wedelia bahamensis</i> (Britton) O.E. Schulz – rong bush	25927	263
1: t. 93.	<i>Anas bahamensis</i> Linnaeus, 1758 – white-cheeked pintail <sup>148</sup>	25928	4 *
	<i>Borrchia arborescens</i> (L.) DC. – tree seaside tansy <sup>149</sup>	25928	4 *
1: t. 94.	<i>Lophodytes cucullatus</i> (Linnaeus, 1758) – hooded merganser <sup>150</sup>	25929	208 *
1: t. 95.	<i>Bucephala albeola</i> (Linnaeus, 1758) – bufflehead <sup>151</sup>	25930	209 *
1: t. 96.	<i>Anas clypeata</i> Linnaeus, 1758 – northern shoveler	25931	224
1: t. 97.	<i>Aix sponsa</i> (Linnaeus, 1758) – wood duck <sup>152</sup>	25932	85 *
1: t. 98.	<i>Bucephala albeola</i> (Linnaeus, 1758) – bufflehead <sup>153</sup>	25933	264 *
	<i>Jacquinia keyensis</i> Mez – joewood	—	—
1: t. 99.	<i>Anas discors</i> Linnaeus (1766) – blue-winged teal (right) <sup>154</sup>	25934	210
1: t. 100.	<i>Anas discors</i> Linnaeus (1766) – blue-winged teal (center) <sup>155</sup>	25935	225 *
<b>-1734-</b>			
2: t. 1.	<i>Sphyræna barracuda</i> (Edwards, 1771; above) – great barracuda <sup>156</sup>	25936	106 *
	<i>Albula vulpes</i> (Linnaeus, 1758; below) – bonefish <sup>157</sup>	25936	106 *
2: t. 2.	<i>Orthopristis chrysoptera</i> (Linnaeus, 1766) – pigfish <sup>158</sup>	25937	166 *
	<i>Synodus foetens</i> (Linnaeus, 1766; below) – inshore lizardfish <sup>159</sup>	25938	167 *
2: t. 3.	<i>Micropogonias undulatus</i> (Linnaeus, 1766; above) – Atlantic croaker <sup>160</sup>	25939	107 *
	<i>Holocentrus rufus</i> (Walbaum, 1792; below) – longspine squirrelfish <sup>161</sup>	25940	86 *
2: t. 4.	<i>Anisotremus virginicus</i> (Linnaeus, 1758; above) – porkfish <sup>162</sup>	25941	6 *
	<i>Lutjanus apodus</i> (Walbaum, 1792; below) – schoolmaster	25942	168
	<i>Albula vulpes</i> (Linnaeus, 1758) – bonefish – not published	25942	168
2: t. 5.	<i>Mycteroperca venenosa</i> (Linnaeus, 1758) – princess rockfish <sup>163</sup>	25943	108 *
2: t. 6.	<i>Diplacanthus formosus</i> (Linnaeus, 1766; above) – sand perch <sup>164</sup>	25944	146 *
	<i>Mugil cephalus</i> Linnaeus, 1758 (probably; below) – gray mullet <sup>165</sup>	25945	187 *
2: t. 7.	<i>Cephalopholis fulva</i> (Linnaeus, 1758; above) – coney <sup>166</sup>	25946	188 *
	<i>Haemulon melamurum</i> (Linnaeus, 1758; below) – cottonwick <sup>167</sup>	25946	188 *
2: t. 8.	Unidentified (probably <i>Exocoetidae</i> ; above) – flying fish	25947	87
	<i>Kyphosus saltatrix</i> (Linnaeus, 1758; middle) – Bahama rudderfish <sup>168</sup>	25948	88 *
	<i>Lepomis gibbosus</i> (Linnaeus, 1758; below) – pumpkinseed <sup>169</sup>	25949	89 *
2: t. 9.	<i>Lutjanus griseus</i> (Linnaeus, 1758) – gray snapper <sup>170</sup>	25950	169 *
2: t. 10.	<i>Acanthurus coeruleus</i> Bloch & Schneider, 1801 (above) – blue	25951	7 *



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	<b>tang</b> <sup>171</sup>		
	<i>Cephalopholis fulva</i> (Linnaeus, 1758) – coney <sup>172</sup>	25952	26 *
2: t. 11.	<i>Gerres cinereus</i> (Walbaum, 1792; above) – yellowfin mojarra <sup>173</sup>	25952	26 *
	<i>Bodianus rufus</i> (Linnaeus, 1758; below) – Spanish hogfish <sup>174</sup>	25953	126 *
2: t. 12.	<i>Haltichoeres radiatus</i> (Linnaeus, 1758; above) – puddingwife <sup>175</sup>	25954	127 *
	<i>Menticirrhus americanus</i> (Linnaeus, 1758; below) – southern kingfish <sup>176</sup>	25955	128 *
2: t. 13.	<i>Ulaema lefroyi</i> (Goode, 1874; probably) – longfinned silverbiddy	25956	147
	<i>Gorgonidae</i> (unidentified; background)	—	—
2: t. 14.	<i>Epinephelus guttatus</i> (Linnaeus, 1758; above) – red hind <sup>177</sup>	25957	46 *
	<i>Pomatomus saltatrix</i> (Linnaeus, 1766; below) – bluefish <sup>178</sup>	25958	47 *
2: t. 15.	<i>Lachnolaimus maximus</i> (Walbaum, 1792) – hogfish <sup>179</sup>	25959	27 *
2: t. 15.	<i>Calamus calamus</i> (Valenciennes, 1830) – saucereye porgy <sup>180</sup>	25960	189 *
2: t. 17.	<i>Lutjanus synagris</i> (Linnaeus, 1758; above) – lane snapper <sup>181</sup>	25961	66 *
	<i>Fistularia tabacaria</i> Linnaeus, 1758 (below) – tobacco trumpetfish <sup>182</sup>	25962	67 *
2: t. 18.	<i>Scarus coeruleus</i> (Edwards, 1771) – blue parrotfish <sup>183</sup>	25963	48 *
2: t. 19.	<i>Aluterus scriptus</i> (Osbeck, 1765) – scrawled filefish <sup>184</sup>	25964	109 *
2: t. 20.	<i>Gymnothorax funebris</i> Ranzani, 1839 – green moray <sup>185</sup>	25965	170 *
2: t. 21.	<i>Gymnothorax moringa</i> (Cuvier, 1829), spotted moray <sup>186</sup>	—	— *
	<i>Gorgonidae</i> (unidentified; background) <sup>187</sup>	—	— *
2: t. 22.	<i>Balistes vetula</i> Linnaeus, 1758 – queen triggerfish <sup>188</sup>	25966	28 *
2: t. 23.	<i>Amenurus catus</i> (Linnaeus, 1758) – white catfish <sup>189</sup>	25967	29 *
2: t. 24.	<i>Elops saurus</i> Linnaeus, 1766 (probably) – ladyfish <sup>190</sup>	—	— *
	<i>Dalbergia ecastaphyllum</i> (L.) Taub. – coinvine	—	—
2: t. 25.	<i>Lutjanus analis</i> (Cuvier, 1828) – mutton snapper <sup>191</sup>	25968	129 *
2: t. 26.	<i>Remora remora</i> (Linnaeus, 1758) – remora <sup>192</sup>	25970	190 *
	<i>Phyllanthus epiphyllanthus</i> L. – swordbush <sup>193</sup>	25969	195 *
2: t. 27.	<i>Bothus lunatus</i> (Linnaeus, 1758) – peacock flounder <sup>194</sup>	25971	68 *
2: t. 28.	<i>Sphoeroides testudineus</i> (Linnaeus, 1758) – checkered puffer	25972	76
	<i>Nectandra coriacea</i> (Sw.) Griseb. (above) – lancewood	25973	69
	<i>Galactia rudolphoides</i> (Griseb.) Benth. & Hook.f. ex C. Wright (below right) – red milk-pea <sup>195</sup>	25973	69 *
2: t. 29.	<i>Sparisoma viride</i> (Bonnaterre, 1788) – stoplight parrotfish <sup>196</sup>	25974	90 *
2: t. 30.	<i>Leptosteus platyrhincus</i> DeKay, 1842 – Florida gar <sup>197</sup>	25975	8 *
	Unknown flowering branch with 6-merous flowers and 4-sided capsules <sup>198</sup>	—	—
	<i>Leucothoe axillaris</i> (Lam.) D. Don, pro parte (fruiting branch)	—	—
2: t. 31.	<i>Holacanthus ciliaris</i> (Linnaeus, 1758) – queen angelfish <sup>199</sup>	25976	9 *
2: t. 32.	<i>Gecarcinus ruricola</i> (Linnaeus, 1758) – purple land crab <sup>200</sup>	25977	30 *
	<i>Picrodendron baccatum</i> (L.) Krug & Urb. – blackwood	25977	30
2: t. 33.	<i>Coenobita clypeatus</i> (Fabricius, 1787) – land hermit crab	25978	171
	<i>Conocarpus erectus</i> L. (above) – button mangrove	25979	177
	<i>Amyris elemifera</i> L. (below) – sea torchwood <sup>201</sup>	25979	177 *
2: t. 34.	<i>Petrochirus diogenes</i> (Linnaeus, 1758) – giant hermit crab <sup>202</sup>	25980	148 *
	<i>Pterogoria</i> sp. [perhaps <i>P. anceps</i> (Pallas, 1766) – angular sea-whip]	—	—
2: t. 35.	<i>Ocyrode quadrata</i> (Fabricius, 1787; above) – Atlantic ghost crab <sup>203</sup>	25981	11 *
	<i>Pseudopterogorgia</i> sp. [probably <i>P. acerosa</i> (Pallas, 1766) –	—	—

Catesby	Scientific Name & Common Name	RL	AHE
	purple sea-plume]		
	<i>Aphonopelma</i> sp. – tarantula – not published	25981	11
2: t. 36.	<i>Grapsus grapsus</i> (Linnaeus, 1758; above) – sally lightfoot crab <sup>204</sup>	25982	70 *
	<i>Calappa flammea</i> (J.F.W. Herbst, 1794) – flame box crab <sup>205</sup>	25982	70 *
2: t. 37.	<i>Dromia erythropus</i> (Edwards 1771; foreground) – redeye sponge crab <sup>206</sup>	25978	171 *
	<i>Muricea muricata</i> (Pallas, 1766), spiny sea-fan <sup>207</sup>	25983	51 *
2: t. 38.	<i>Chelonia mydas</i> (Linnaeus, 1758) – green sea turtle	25984	110
	<i>Thalassia testudinum</i> König – turtlegrass	—	—
2: t. 39.	<i>Eretmochelys imbricata</i> (Linnaeus, 1766) – hawksbill sea turtle <sup>208</sup>	25985	49 *
2: t. 40.	<i>Caretta caretta</i> (Linnaeus, 1758) – loggerhead sea turtle	25986	10
	<i>Vachellia choriophylla</i> (Benth.) Seigler & Ebinger – cinnecord – not published	25986	10
–1736–			
2: t. 41.	<i>Crotalus horridus</i> Linnaeus, 1758 – timber rattlesnake	25987	131
2: t. 42.	<i>Sistrurus miliaris</i> (Linnaeus, 1766) – pygmy rattlesnake <sup>209</sup>	25989	152 *
	Unidentified insect – not published	25989	152
	<i>Lysiloma latisiliquum</i> (L.) Benth. – false tamarind	—	—
	<i>Banara minutiflora</i> (A. Rich.) Sleumer – banara	25988	151
2: t. 43.	<i>Agkistrodon piscivorus</i> (Lacépède, 1789) – eastern cottonmouth	25990	172
	<i>Leucothoe racemosa</i> (L.) A. Gray – swamp doghobble <sup>210</sup>	25885	249 *
2: t. 44.	<i>Heterodon platirhinos</i> Latreille, 1801 – eastern hognose snake	25991	153
	<i>Vachellia tortuosa</i> (L.) Seigler & Ebinger – poponax	—	—
2: t. 45.	<i>Heterodon platirhinos</i> Latreille, 1801 – eastern hognose snake	25992	91
	<i>Bos taurus</i> Linnaeus, 1758 – domestic cattle – not published	25992	91
	Unidentified salamander	—	—
	<i>Xanthosoma sagittifolium</i> (L.) Schott – arrowleaf elephant's-ear	—	—
2: t. 46.	<i>Nerodia erythrogaster</i> (Forster, 1771) – redbellied water snake <sup>211</sup>	25993	191 *
	<i>Croton eluteria</i> (L.) W. Wight – cascarilla <sup>212</sup>	—	— *
2: t. 47.	<i>Ophedrys aestivus</i> (Linnaeus, 1766) – rough green snake <sup>213</sup>	25994	50 *
	<i>Callicarpa americana</i> L. (above) – American beautyberry <sup>214</sup>	25994	50 *
2: t. 48.	<i>Elaphe obsoleta</i> Say, 1823 – black rat snake <sup>215</sup>	25995	192 *
	<i>Cissus obovata</i> Vahl. – spoonleaf treebine	25996	192
2: t. 49.	<i>Storeria dekayi</i> (Holbrook, 1839) – brown snake	25997	71
	<i>Erythrina herbacea</i> L. – coral bean <sup>216</sup>	25997	71 *
2: t. 50.	<i>Thamnopis sauritus</i> (Linnaeus, 1766) – eastern ribbon snake <sup>217</sup>	25998	111 *
	<i>Canella winterana</i> (L.) Gaertn. – wild cinnamon <sup>218</sup>	25999	111 *
2: t. 51.	<i>Thamnopis sauritus</i> (Linnaeus, 1766) – eastern ribbon snake <sup>219</sup>	25999	173 *
	<i>Caesalpinia bahamensis</i> Lam. – brasiletto <sup>220</sup>	25999	173 *
	<i>Passiflora suberosa</i> L. – corkstem passionflower	25999	173
2: t. 52.	<i>Lampropeltis getula</i> (Linnaeus, 1766) – eastern kingsnake <sup>221</sup>	26000	193 *
	<i>Leucothoe axillaris</i> (Lam.) D. Don (right) – coastal doghobble	25885	249
2: t. 53.	<i>Thamnopis sirtalis</i> (Linnaeus, 1758) – common gartersnake <sup>222</sup>	26001	212 *
	<i>Pentalinon luteum</i> (L.) B.F. Hansen & Wunderlin – hammock viper's-tail <sup>223</sup>	—	— *
2: t. 54.	<i>Masticophis flagellum</i> (Shaw, 1802) – eastern coachwhip <sup>224</sup>	26002	213 *
	<i>Silene virginica</i> L. – fire pink	26002	213
2: t. 55.	<i>Elaphe guttata</i> (Linnaeus, 1766) – corn snake – see 2: t. 60 below.	26003	214
	<i>Polystachya concreta</i> (Jacq.) Garay & H.R. Sweet – greater	26003	214

Catesby	Scientific Name & Common Name	RL	AHE
	yellowspike orchid	26030	18
2: t. 56.	<i>Heterodon platirhinos</i> Latreille, 1801 – eastern hog-nosed snake <sup>225</sup>	26004	215 *
	<i>Lilium superbum</i> L. – turk's-cap lily (overall aspect; buds and right flower) <sup>226</sup>	26005	156 *
	<i>Lilium michauxii</i> Poit. – Carolina lily (left flower and whorl of leaves)	26006	16
2: t. 57.	<i>Ophedrys vernalis</i> (Harlan, 1827) – smooth green snake <sup>227</sup>	26007	12 *
	<i>Ilex vomitoria</i> Aiton – yaupon <sup>228</sup>	26002	12
2: t. 58.	<i>Farancia abacura</i> Holbrook, 1836 – eastern mud snake <sup>229</sup>	26008	52 *
	<i>Lilium catesbaei</i> Walter – pine lily	26008	52
	<i>Lilium catesbaei</i> Walter – pine lily	26009	96
	<i>Lilium superbum</i> L. – Turk's-cap lily – not published	26009	96
2: t. 59.	<i>Ophisaurus ventralis</i> (Linnaeus, 1766) – eastern grass snake <sup>230</sup>	26010	132 *
	<i>Echinacea laevigata</i> (C.L. Boynton & Beadle) S.F. Blake – smooth purple coneflower	—	—
2: t. 60.	<i>Cemophora coccinea</i> (Blumenbach, 1788) – scarlet snake <sup>231</sup>	26011	31 *
	<i>Ipomoea batatas</i> (L.) Lam. – sweet potato <sup>232</sup>	26011	31 *
–1738–			
2: t. 61.	<i>Magnolia grandiflora</i> L. – southern magnolia <sup>233</sup>	—	— *
2: t. 62.	<i>Spilogale putorius</i> (Linnaeus) – eastern spotted skunk <sup>234</sup>	26013	13 *
	<i>Commelina erecta</i> L. (below) – erect dayflower	25994	50
2: t. 63.	<i>Alligator mississippiensis</i> (Daudin, 1802) – alligator <sup>235</sup>	—	— *
	<i>Rhizophora mangle</i> L. – American mangrove	26014	—
2: t. 64.	<i>Cyclura cornuta</i> (Bonnaterre, 1789) – horned ground iguana <sup>236</sup>	26015	133 *
	<i>Annona glabra</i> L. – pond-apple <sup>237</sup>	26015	133 *
2: t. 65.	<i>Anolis carolinensis</i> Voigt, 1832 – green anole <sup>238</sup>	26016	53 *
	<i>Liquidambar styraciflua</i> L. – sweetgum <sup>239</sup>	26016	53 *
2: t. 66.	<i>Norops garmani</i> (Stejneger) – Jamaican giant anole <sup>240</sup>	26018	154 *
	<i>Haematoxylum campechianum</i> L. – bloodwood tree <sup>241</sup>	26017	17 *
2: t. 67.	<i>Eumeces fasciata</i> (Linnaeus, 1758) – five-lined skink <sup>242</sup>	26018	154 *
	<i>Annona glabra</i> L. – pond-apple <sup>243</sup>	—	— *
2: t. 68.	<i>Cnemidophorus sexlineatus</i> (Linnaeus, 1766) – six-lined racerunner <sup>244</sup>	—	— *
	<i>Epidendrum nocturnum</i> Jacq. – night scented orchid	26019	199
2: t. 69.	<i>Anaxyrus terrestris</i> (Bonnaterre, 1789) – southern toad <sup>245</sup>	26020	54 *
	<i>Anaxyrus terrestris</i> (Bonnaterre, 1789) – southern toad	26023	113 *
	<i>Pyrophorus noctilucus</i> (Linnaeus, 1758) – fire beetle	26020	54
	<i>Sarracenia minor</i> Walter (left) – nodding pitcherplant <sup>246</sup>	26020	54 *
	<i>Sarracenia flava</i> L. (right) – yellow pitcherplant <sup>247</sup>	26020	54 *
2: t. 70.	<i>Lithobates pipiens</i> (Schreber, 1782) – northern leopard frog	26021	72
		26023	113
	<i>Sarracenia purpurea</i> L. – purple pitcherplant <sup>248</sup>	26021	72 *
	<i>Sarracenia purpurea</i> L. – purple pitcherplant (leaf on right)	26022	112
2: t. 71.	<i>Hyla cinerea</i> (Schneider, 1799) – green tree frog <sup>249</sup>	26023	113 *
	<i>Peuceetia viridans</i> (Hentz, 1832) – green lynx spider <sup>250</sup>	26024	92
	<i>Symplocarpus foetidus</i> (L.) Salisb. ex W.P.C. Barton – skunk cabbage	26024	92
2: t. 72.	<i>Lithobates catesbeianus</i> (Shaw, 1802) – bullfrog <sup>251</sup>	26025	33

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Cypripedium acaule</i> Aiton – pink lady's-slipper <sup>252</sup>	26026	77 *
2: t. 73.	<i>Sciurus niger</i> Linnaeus, 1758 – eastern fox squirrel <sup>253</sup>	26028	134 *
	<i>Cypripedium pubescens</i> Willd. – greater yellow lady's-slipper <sup>254</sup>	26027	219 *
2: t. 74.	<i>Sciurus carolinensis</i> J.F. Gmelin, 1758 – eastern gray squirrel <sup>255</sup>	26029	155 *
	<i>Prosthechea boothiana</i> (Lindl.) W.E. Higgins – dollar orchid	26030	18
2: t. 75.	<i>Tamias striatus</i> (Linnaeus, 1758) – eastern chipmunk <sup>256</sup>	26032	73 *
	<i>Sideroxylon foetidissimum</i> Jacq. – false mastic	26031	179
	<i>Calycanthus floridus</i> L. – eastern sweetshrub	—	—
	<i>Carya</i> sp. – hickory (nut) – not published	26032	73
2: t. 76.	<i>Glaucomys volans</i> (Linnaeus, 1758) – southern flying squirrel eating a common persimmon <sup>257</sup>	26034	174 *
	<i>Diospyros virginiana</i> L. – common persimmon <sup>258</sup>	26033	179 *
2: t. 77.	<i>Glaucomys volans</i> (Linnaeus, 1758) – southern flying squirrel <sup>259</sup>	26036	115 *
	<i>Catopsis berteroniana</i> (Schult.f.) Mez – powdery strap airplant	26035	114
2: t. 78.	<i>Urocyon cinereoargenteus</i> (Schreber, 1778) – common gray fox <sup>260</sup>	26038	135 *
	<i>Spigelia marilandica</i> (L.) L. – Indianpink <sup>261</sup>	26037	200 *
2: t. 79.	<i>Geocapromys ingrahami</i> Allen, 1891 – Bahaman hutia	26039	55
	<i>Bourreria baccata</i> Raf. (above) – bodywood <sup>262</sup>	25996	178 *
	<i>Magnolia virginiana</i> L. – sweetbay – not published	26040	157
2: t. 80.	<i>Magnolia tripetala</i> (L.) L. – umbrella magnolia <sup>263</sup>	26041	158 *
	<i>Magnolia tripetala</i> (L.) L. – umbrella magnolia (fruit only)	26012	240
–1743–			
2: t. 81.	<i>Swietenia mahagoni</i> (L.) Jacq. (top and right) – West Indian mahogany <sup>264</sup>	26042	136 *
	<i>Phoradendron rubrum</i> (L.) Griseb. (bottom left) – mahogany mistletoe <sup>265</sup>	26058	97 *
2: t. 82.	<i>Bignonia capreolata</i> L. – cross vine	26043	56
2: t. 83.	<i>Papilio glaucus</i> (Linnaeus, 1758) – tiger swallowtail <sup>266</sup>	26045	93 *
	<i>Ptelea trifoliata</i> L. – common hoptree	26045	93
2: t. 84.	<i>Actias luna</i> (Linnaeus, 1758) – luna moth <sup>267</sup>	26046	137 *
	<i>Actias luna</i> (Linnaeus, 1758) – luna moth cocoon (upper right corner)	26046	137
	<i>Philadelphus inodorus</i> L. (above) – scentless mock-orange <sup>268</sup>	26046	137 *
	<i>Smilax smallii</i> Morong (below; twining) – lanceleaf greenbrier <sup>269</sup>	26046	137
2: t. 85.	<i>Asimina triloba</i> (L.) Dunal – pawpaw <sup>270</sup>	26047	119 *
2: t. 86.	<i>Hyalophora cecropia</i> (Linnaeus, 1758) – cecropia moth <sup>271</sup>	26048	138 *
	<i>Annona reticulata</i> L. – netted pawpaw	26048	138
2: t. 87.	<i>Manilkara jaimiqui</i> (C. Wright) Dubard subsp. <i>emarginata</i> (L.) Cronquist – wild dilly <sup>272</sup>	26049	78 *
	<i>Ipomoea microdactyla</i> Griseb. – calcareous morning-glory	26049	78
2: t. 88.	<i>Danaus plexippus</i> (Linnaeus, 1758) – monarch butterfly <sup>273</sup>	26050	159 *
	<i>Encyclia plicata</i> (Lindl.) Schltr. (left) – pleated encyclia	26050	159
	<i>Prosthechea cochleata</i> (L.) W.E. Higgins (right) – clamshell orchid <sup>274</sup>	26050	159 *
	<i>Prosthechea boothiana</i> (Lindl.) W.E. Higgins (above left) – dollar orchid – not published	26050	159
2: t. 89.	<i>Dissosteira carolinus</i> (Linnaeus, 1758) – Carolina grasshopper <sup>275</sup>	26051	13 *
	<i>Tillandsia balbisiana</i> Schult.f. – northern needleleaf <sup>276</sup>	26051	13 *
2: t. 90.	<i>Antheraea polyphemus</i> (Cramer, 1775), sen. lat. – polyphemus	26053	14

Catesby	Scientific Name & Common Name	RL	AHE
	moth		
	<i>Talipariti tiliaceum</i> (L.) Fryxell – tree hibiscus	26052	180
2: t. 91.	<i>Antheraea polyphemus</i> (Cramer, 1775), sen. lat. – polyphemus moth <sup>277</sup>	26053	14 *
	<i>Cordia sebestena</i> L. – geiger-tree <sup>275</sup> 8	26054	139 *
	<i>Ipomoea carolina</i> L. – tievine <sup>279</sup>	26054	139 *
2: t. 92.	<i>Plumeria rubra</i> L. – frangipani <sup>280</sup>	26055	19 *
2: t. 93.	<i>Plumeria obtusa</i> L. – Singapore frangipani <sup>281</sup>	26056	57 *
	<i>Passiflora cuprea</i> L. – no common name <sup>282</sup>	26056	57 *
2: t. 94.	<i>Citheronia regalis</i> (Fabricius, 1793) – horned devils caterpillar <sup>283</sup>	25988	151 *
	<i>Coccoloba diversifolia</i> Jacq. – pigeon-plum	26057	220
2: t. 95.	<i>Zerynthia rumina</i> (Linnaeus, 1758) – Spanish festoon <sup>284</sup>	—	— *
	<i>Hippomane mancinella</i> L. (above) – manchineel <sup>285</sup>	26058	97 *
	<i>Dendropemon purpureus</i> (L.) Krug & Urb. (below) – smooth leechbush <sup>286</sup>	26058	97 *
2: t. 96.	<i>Utetheisa bella</i> (Linnaeus, 1758) – ornate moth <sup>287</sup>	26059	175 *
	<i>Coccoloba uvifera</i> (L.) L. – sea-grape <sup>288</sup>	26059	175 *
2: t. 97.	<i>Papilio glaucus</i> Linnaeus, 1758 – tiger swallowtail	26044	74
	<i>Pithecellobium</i> × <i>bahamense</i> Northr. – Bahaman cat's claw	26060	37
2: t. 98.	<i>Kalmia latifolia</i> L. – mountain laurel (composite drawing) <sup>289</sup>	26061	58 *
	<i>Kalmia latifolia</i> L. – mountain laurel (original drawing)	26062	98
	<i>Kalmia latifolia</i> L. – mountain laurel (below; right branch)	26046	137
2: t. 99.	<i>Clusia rosea</i> Jacq. – Scotch attorney <sup>290</sup>	26063	20 *
2: t. 100.	<i>Protographum marcellus</i> (Cramer, 1777) – zebra swallowtail <sup>291</sup>	26064	34 *
	<i>Catesbaea spinosa</i> L. – lily thorn <sup>2892</sup>	26064	34 *
–1747–			
2App.: t. 1.	<i>Tympanuchus cupido</i> (Linnaeus, 1758) – greater prairie chicken <sup>293</sup>	—	— *
	<i>Primula meadia</i> (L.) Mast & Reveal – pride-of-Ohio <sup>294</sup>	26065	38 *
2App.: t. 2.	<i>Scolopendra alternans</i> Leach, 1813 (probably) – Florida Keys centipede	26067	194
	<i>Hamamelis virginiana</i> L. – witch hazel <sup>295</sup>	26066	39 *
2App.: t. 3.	<i>Crotophaga ani</i> Linnaeus, 1758 – smooth-billed ani <sup>296</sup>	26068	104 *
	<i>Cypripedium acaule</i> Aiton – pink lady's-slipper <sup>297</sup>	26069	35 *
Catesby	Scientific Name & Common Name	RL	AHE
2App.: t. 4.	<i>Megarhyssa atrata</i> (Fabricius, 1781) – giant ichneumon wasp	26069	35
	<i>Rhus glabra</i> L. – smooth sumac	26071	99
2App.: t. 5.	<i>Icterus icterus</i> (Linnaeus, 1766) – troupiat <sup>298</sup>	26070	5 *
	<i>Chalybion californicum</i> (de Saussure, 1867) – blue mud wasp <sup>299</sup>	26070	5 *
	<i>Pancreatum maritimum</i> L. – sea-daffodil <sup>300</sup>	26070	5 *
2App.: t. 6.	<i>Theobroma cacao</i> L. – cacao <sup>301</sup>	26072	79 *
2App.: t. 7.	<i>Vanilla mexicana</i> Mill. – Mexican vanilla <sup>302</sup>	26073	59 *
2App.: t. 8.	<i>Chaetura pelagica</i> (Linnaeus, 1758) – chimney swift <sup>303</sup>	26075	144 *
	<i>Lilium philadelphicum</i> L. – wood lily	26074	160
2App.: t. 9.	<i>Anacardium occidentale</i> L. – cashew <sup>304</sup>	26076	40 *
2App.: t. 10.	<i>Ardea herodias</i> Linnaeus, 1758 – great blue heron <sup>305</sup>	26078	125 *
	<i>Ambystoma maculatum</i> (Shaw, 1802; in bill) – spotted salamander <sup>306</sup>	26018	154 *
	<i>Hypercompe scribtonia</i> (Stoll, 1787) – giant leopard moth (top right) <sup>307</sup>	26077	94

Catesby	Scientific Name & Common Name	RL	AHE
	<i>Periplaneta americana</i> (Linnaeus, 1758, above, right) – American cockroach	26077	94 *
	Unidentified beetle sketch (below, left)	26077	94
	Unidentified beetles (bottom, middle)	26077	94
	<i>Tunga penetrans</i> (Linnaeus, 1758; middle, right) – chigoe flea and egg <sup>308</sup>	26077	94 *
2App.: t. 11.	<i>Canthon pithularius</i> (Linnaeus, 1758) – dung beetle (below, left) <sup>309</sup>	26077	94 *
	<i>Phanaeus vindex</i> Macleay, 1819 (below right) – rainbow scarab beetle <sup>310</sup>	26077	94 *
	<i>Lilium canadense</i> L. – Canada lily <sup>311</sup>	26079	80 *
2App.: t. 12.	<i>Colinus virginianus</i> (Linnaeus, 1758) – northern bobwhite <sup>312</sup>	26080	185 *
	<i>Zephyranthes atamasca</i> (L.) Herb. – Atamasco lily <sup>313</sup>	26081	25 *
2App.: t. 13.	<i>Regulus satrapa</i> Lichtenstein, 1823 – golden-crown kinglet; altered to in 1771 to <i>R. calendula</i> (Linnaeus, 1766) – ruby-crowned kinglet <sup>314</sup>	26081	25 *
	<i>Sceliphron caementarium</i> (Drury, 1773) – black and yellow mud-dauber	26077	94
	<i>Stewartia malacodendron</i> L. – silky camellia <sup>315</sup>	26082	100 *
2App.: t. 14.	<i>Phaethon aethereus</i> Linnaeus, 1758 (above) – red-billed tropicbird <sup>316</sup>	26083	145 *
	<i>Hydrobates pelagicus</i> (Linnaeus, 1758; below) – European storm-petrel <sup>317</sup>	26083	145 *
2App.: t. 15.	<i>Dasytmilla occidentalis</i> (Linnaeus, 1758) – velvet ant <sup>318</sup>	26077	94 *
	<i>Magnolia acuminata</i> (L.) L. – cucumber-tree <sup>319</sup>	26081	25
	<i>Chordeiles minor</i> (Forster, 1771) – common nighthawk <sup>320</sup>	26084	60 *
2App.: t. 16.	<i>Panax quinquefolius</i> L. – American ginseng <sup>321</sup>	26085	105 *
	<i>Panax quinquefolius</i> L. – American ginseng <sup>321</sup>	26085	105 *
2App.: t. 17.	<i>Kalmia angustifolia</i> L. (left) – lamb laurel <sup>322</sup>	26086	120 *
	<i>Rhododendron maximum</i> L. (right) – great laurel <sup>323</sup>	26086	120 *
2App.: t. 18.	<i>Dasyprocta leporina</i> (Linnaeus, 1758) – Brazilian agouti <sup>324</sup>	26087	95 *
	<i>Ficus citrifolia</i> Mill. – shortleaf fig <sup>325</sup>	—	— *
	<i>Pristis pristis</i> (Linnaeus, 1758) – common sawfish – not published	26093	130
	<i>Ficus citrifolia</i> Mill. – shortleaf fig – not published	26093	130
2App.: t. 19.	<i>Acanthodoras cataphractus</i> (Linnaeus, 1758; above) – spiny catfish <sup>326</sup>	26088	149 *
	<i>Chauliodus sloani</i> Bloch & Schneider, 1801 (below) – viperfish	26089	149
2App.: t. 20.	<i>Bison bison</i> (Linnaeus, 1758) – American buffalo <sup>327</sup>	26090	15 *
	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp. – quickstick	26090	15
	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp. (sketch) – quickstick	26092	130
	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp. – quickstick – not published	26091	140
	<i>Bison bison</i> Linnaeus, 1758 – American bison – not published	26092	75

## Footnotes

Lectotypes and syntypes associated with Catesby's published plant images are noted along with an indication the author(s) who designated each lectotype. Plates devoted only to animals were not reviewed by Reveal in 2009 although in an appendix an attempt was made, when possible, to assign each a scientific and common name. Here, all 220 images are discussed with a reference to whom cited a Catesby image when a new animal taxon was proposed. The code of nomenclature for

zoology does not consider an image to be a type so neotypes occasionally have been designated for names based in whole or part on a published Catesby etching. No effort has been made here to ascertain whom or where such neotypes have been effectively published. To avoid any hint as to the type status for any zoological name only a reference to the basionym or presently accepted name is given here. Nonetheless, as may be seen, many of the animals were known to Linnaeus and other authors only from the published image.

<sup>1</sup> Linnaeus (1766: 124) under *Falco leucocephalus*; two references, one image. The fish may be the gray mullet, *Mugil cephalus*; Linnaeus made no reference to Catesby in describing the mullet.

<sup>2</sup> Gmelin (1788: 263) under *Falco carolinensis*, a synonym; four references and four images. Linnaeus did not cite this image in his works; see footnote 1 for the fish.

<sup>3</sup> Linnaeus (1758: 90); the only reference cited.

<sup>4</sup> Linnaeus (1758: 89) under *Falco forficatus*; the only reference cited.

<sup>5</sup> Linnaeus (1758: 90); the only reference cited.

<sup>6</sup> Linnaeus (1758: 86) under *Vultur aura*; six citations and one of two images

<sup>7</sup> Linnaeus (1758: 92) under *Strix asio*; the only reference cited.

<sup>8</sup> Forster (1771a: 13) under *Caprimulgus minor*; the only reference cited. Gmelin (1789: 1028) under *Caprimulgus virginianus*; eight references and five images. Wilson (1812: 71) discussed the Catesby published etching but did not base his name on that image.

<sup>9</sup> Linnaeus (1758: 428) under *Gryllus gryllotalpa*; eleven references, five with images. Scudder (1862: 426) under *Gryllotalpa longipennis*; the only reference cited.

<sup>10</sup> Linnaeus (1758: 111) under *Cuculus americanus*; the only reference cited.

<sup>11</sup> Linnaeus (1753: 998) under *Fagus pumila* (syntype); lectotype: Clayton 927 (BM-Clayton), designated by Johnson (1988: 41).

<sup>12</sup> Linnaeus (1758: 101) under *Psittacus paradisae*; the only reference cited.

<sup>13</sup> Linnaeus (1758: 97) under *Psittacus carolinensis*; the only reference cited.

<sup>14</sup> Linnaeus (1753: 1003) under *Cupressus disticha* (syntype); lectotype: Herb. Linn. No. 1137.2 (LINN), designated by Wijnands (1983: 196).

<sup>15</sup> Linnaeus (1758: 109) under *Monedula quiscula*; two references and one image.

<sup>16</sup> Linnaeus (1766: 161) under *Oriolus phoeniceus*; six reference and three images.

<sup>17</sup> Müller (1768: *Myrica* no. 3) under *Myrica carolinensis*; lectotype: [icon.] Catesby Nat. Hist. Carolina 1: t. 13. 1729, designated by Wilbur (2002: 39).

<sup>18</sup> Linnaeus (1758: 179) under *Fringilla oryzivora*; two references and one image.

<sup>19</sup> Linnaeus (1753: 333; syntype); lectotype: Herb. Linn. No. 460.1 (LINN), designated by Meikle (1985: 1716).

<sup>20</sup> Linnaeus (1758: 106) under *Corvus cristatus*; the only reference cited.

<sup>21</sup> Linnaeus (1753: 1030; syntype); lectotype: Clayton 617, Herb. Linn. No. 1182.9 (LINN), designated by Reveal in Jarvis (2007: 858).

<sup>22</sup> Linnaeus (1758: 113) under *Picus principalis*; the only reference cited.

<sup>23</sup> Linnaeus (1753: 994; syntype); lectotype: Clayton 780 (BM-Clayton), designated by Reveal et al. (1987: 233).

<sup>24</sup> Linnaeus (1758: 113) under *Picus pileatus*; three references and two images.

<sup>25</sup> Linnaeus (1753: 994) under *Quercus phellos* var.  $\beta$ ; Miller (1768: *Quercus* no. 16); neotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 17. 1729, designated by Reveal (2009: 280).

<sup>26</sup> Linnaeus (1758: 112) under *Cuculus auratus*; the only reference cited.

<sup>27</sup> Linnaeus (1753: 995) under *Quercus prinus* (syntype), a rejected name.

<sup>28</sup> Linnaeus (1758: 113) under *Picus carolinus*; the only reference cited.

<sup>29</sup> Linnaeus (1766: 175) under *Picus villosus*; three references and one image.

<sup>30</sup> Linnaeus (1753: 996) under *Quercus nigra* var.  $\beta$ ; Münchhausen (1770: 253); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 19. 1729, designated by Reveal et al. (1987: 232).

<sup>31</sup> Linnaeus (1758: 113) under *Picus erythrocephalus*; the only reference cited.

- <sup>32</sup> Linnaeus (1753: 995; syntype); see Reveal (2009: 281) for a discussion of the nomenclatural problems associated with the current typification of this name.
- <sup>33</sup> Linnaeus (1753: 111; syntype); lectotype: Herb. Linn. No. 135.1 (LINN), designated by Reveal et al. (1987: 215).
- <sup>34</sup> Linnaeus (1766: 176) under *Picus varus*; two references and one image.
- <sup>35</sup> Linnaeus (1766: 175) under *Picus pubescens*; two references and one image.
- <sup>36</sup> Linnaeus (1753: 996; syntype); lectotype: Herb. Linn. No. 1128.6 (LINN), designated by Nixon and Barrie in Jarvis (2007: 783).
- <sup>37</sup> Linnaeus (1753: 996) under *Quercus rubra* var.  $\beta$ .
- <sup>38</sup> Latham (1790: 263); numerous references and at least five images.
- <sup>39</sup> Latham (1790: 262); numerous references and at least four images.
- <sup>40</sup> Linnaeus (1753: 994) under *Quercus phellos* var.  $\gamma$ ; neotype of *Q. incana* W. Bartram (1791: 378, 403); [icon.] Catesby, Nat. Hist. Carolina 1: t. 22. 1730, designated by Reveal (2009: 282); syntype of *Q. cinerea* Michx. (1801: 8).
- <sup>41</sup> Linnaeus (1758: 164) under *Columba macroura*; see footnote no. 43, below; Linnaeus (1766: 285) under *Columba migratoria*; four references and one image.
- <sup>42</sup> Linnaeus (1753: 996) under *Quercus rubra*; Michaux (1801: 17) under *Q. catesbaei*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 23. 1730, designated by Howard and Staples (1983: 525).
- <sup>43</sup> Linnaeus (1758: 164) under *Columba macroura*; two references and one image. Linnaeus (1766: 286) under *Columba carolinensis*, a synonym; four references and two images, see footnote 41, above.
- <sup>44</sup> Linnaeus (1753: 505; syntype); lectotype: Herb. Linn. No. 667.1 (LINN), designated by Reveal in Jarvis et al. (1993: 77).
- <sup>45</sup> Linnaeus (1758: 164) under *Columba leucocephala*; three references and two images.
- <sup>46</sup> Linnaeus (1758: 165) under *Columba passerine*; seven references and images.
- <sup>47</sup> Linnaeus (1753: 270); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 26. 1730, designated by Reveal (2009: 284).
- <sup>48</sup> Linnaeus (1758: 169) under *Turdus polyglottos*; four references and two images.
- <sup>49</sup> Linnaeus (1753: 117; syntype); lectotype: *Clayton 51* (BM-Clayton), designated by Reveal et al. in Jarvis (2007: 448) where, in one place, "*Clayton 23*" (the number on the herbarium sheet but seemingly not a Clayton collection number) is given.
- <sup>50</sup> Linnaeus (1758: 169) under *Turdus rufus*; the only reference cited.
- <sup>51</sup> Linnaeus (1753: 473). See Gandhi et al. (2009: 312) and the discussion in Reveal (2009: 286). As pointed out by Gandhi et al., the Catesby watercolor is *Prunus virginiana* but the discussion and Catesby's published plate (t. 28) is a composite of the choke cherry, *P. virginiana* (inflorescences), and the black cherry, *P. serotina* Ehrh. (leaves). A proposal to conserve *P. virginiana* to maintain current use has yet to be acted upon. The traditional type of *P. virginica*, *J. Clayton 627* (BM-Clayton), supposedly selected by Mackenzie (1928: 235; but see Jarvis 2007: 785 who maintains that indeed Mackenzie designate a lectotype), is a gathering of *P. serotina*. As a result, *P. virginiana*, unless conserved on the specimen suggested by Gandhi et al. is adopted, must be applied to the black cherry or alternatively (as discussed by Reveal et al. [1989: 217]) the name has equal priority with *Itea virginica* L. At the moment, the nomenclaturally correct name for the choke cherry is *P. canadensis* L. (Sp. Pl., ed. 2, 1: 678. 1762) but is not adopted here awaiting a final decision.
- <sup>52</sup> Linnaeus (1766: 292); three references and one image.
- <sup>53</sup> Linnaeus (1753: 961; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 1071.1 (LINN).
- <sup>54</sup> Linnaeus (1758: 169); the only reference cited.
- <sup>55</sup> Linnaeus (1753: 1026) under *Pistacia simaruba* (syntype); lectotype: [icon.] Sloane, Voy. Jamaica Nat. Hist. 2: t. 199. 1725, designated by Wijnands (1983: 55).



- <sup>56</sup> Linnaeus (1753: 125; syntype); lectotype: Herb. Linn. No. 173.3 (LINN), designated by González et al. (in Greuter and Rankin Rodríguez, 2004: 10).
- <sup>57</sup> Linnaeus (1758: 166) under *Alauda alpestris*; the only reference cited.
- <sup>58</sup> Linnaeus (1758: 167) under *Alauda magna*; the only reference cited.
- <sup>59</sup> Linnaeus (1758: 180) under *Fringilla erythrophthalma*; the only reference cited.
- <sup>60</sup> Linnaeus (1753: 1034) under *Populus balsamifera* (syntype).
- <sup>61</sup> Linnaeus (1758: 183) under *Fringilla hyemalis*; the only reference cited.
- <sup>62</sup> Linnaeus (1753: 387; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 551.3 (LINN), designated by Wallace (1975: 31).
- <sup>63</sup> Linnaeus (1758: 183) under *Fringilla zena* (the only reference cited), non Linnaeus (1758: 181); Linnaeus (1766: 324) under *Fringilla bicolor*; two references and one image.
- <sup>64</sup> Linnaeus (1753: 624) under *Bignonia leucoxylon* (syntype); Linnaeus (1763: 870) under *B. pentaphylla*, *nom. illeg.*
- <sup>65</sup> Linnaeus (1758: 172) under *Loxia cardinalis*; nine references and eight images.
- <sup>66</sup> Linnaeus (1753: 997) under *Juglans alba* (syntype); *J. glabra* (Miller, 1768: *Juglans* no.5) has yet to be lectotypified.
- <sup>67</sup> Linnaeus (1758: 175) under *Loxia caerulea*; the only reference cited.
- <sup>68</sup> Linnaeus (1753: 535) under *Magnolia virginiana* var. *glabra*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 39, 1730, designated by Dandy (1958: 112); the only reference cited.
- <sup>69</sup> Linnaeus (1758: 176) under *Loxia violacea*; the only reference.
- <sup>70</sup> Linnaeus (1759: 1000) under *Amyris toxicifera*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 40, 1730, designated by Howard (1989: 99).
- <sup>71</sup> Gmelin (1789: 923) under *Fringilla purpurea*; five references and four images.
- <sup>72</sup> Marshall (1785: 97); neotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 41, 1730, designated by Howard and Staples (1983: 533).
- <sup>73</sup> Linnaeus (1758: 181) under *Fringilla zena*; the only reference.
- <sup>74</sup> Linnaeus (1753: 625) under *Bignonia caerulea*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 42, 1730, designated by Dandy (1958: 112).
- <sup>75</sup> Linnaeus (1758: 181) under *Fringilla tristis*; the only reference cited.
- <sup>76</sup> Marshall (1785: 54); neotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 43, 1730, designated by Reveal (2009: 294).
- <sup>77</sup> Linnaeus (1758: 179) under an unnamed variant of *Emberiza ciris*; the only reference cited.
- <sup>78</sup> Linnaeus (1753: 783) under *Hypericum lasianthus*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 44, 1730, designated by Reveal in Jarvis (2007: 583).
- <sup>79</sup> Linnaeus (1766: 315) under *Tanagra cyanea*; two references and two images.
- <sup>80</sup> Linnaeus (1758: 339) under *Trillium cernuum* (syntype).
- <sup>81</sup> Linnaeus (1758: 95) under *Ampelis garrulus* β (Linnaeus, 1758: 95); the only reference cited. Also erroneously cited under *Certhia pinus* Linnaeus (1766: 187), as one of three references and two images; see 1: t. 61 and footnote 109.
- <sup>82</sup> Linnaeus (1759: 1066; syntype); lectotype: *P. Miller s.n.*, Herb. Linn. No. 660.1 (LINN), designated by Nicely (1965: 66).
- <sup>83</sup> Linnaeus (1758: 187) under *Motacilla stalis*; two references and images cited.
- <sup>84</sup> Miller (1768: *Smilax* no. 3) under *Smilax humilis*, a rejected name; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 47, 1730, designated by Reveal (2000: 297).
- <sup>85</sup> Linnaeus (1758: 108) under *Coracias galbula*; the only reference cited. Linnaeus (1766: 162) under *Oriolus baltimora*, a synonym; two references and images.
- <sup>86</sup> Linnaeus (1753: 535; syntype); lectotype: [icon.] Herb. Clifford: 223, *Liriodendron* No. 1A (BM), designated by Reveal in Jarvis et al. (1993: 62).
- <sup>87</sup> Linnaeus (1766: 162) under *Oriolus spurius*; two references and images.
- <sup>88</sup> Walter (1788: 64), a new name based on *Bignonia catalpa* (Linnaeus 1753: 622); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 49, 1730, designated by Reveal et al. (1990: 17). Walter, who

- cited Linnaeus as the basis for his names, did not propose a new species as suggested by Ward (2007: 1098), contrary to his (Ward 2010) objections on a similar case.
- <sup>89</sup> Linnaeus (1758: 171) under *Turdus virens*; the only reference cited.
- <sup>90</sup> Linnaeus (1753: 340) under *Trillium sessile*; lectotype: *Clayton 856* (BM-Clayton), designated by Freeman (1975: 11).
- <sup>91</sup> Linnaeus (1766: 344) under *Hirundo purpurea*, a synonym; three references and one image.
- <sup>92</sup> Linnaeus (1753: 1032) under *Cissampelos smilacina*, a synonym; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 51. 1730, designated by Howard and Staples (1983: 532). No known material of *Minispermum carolinum* (Linnaeus 1753: 340) resulted in the designation of a neotype (Godfrey & Tryon 373) by Reveal and Jarvis (2009: 980).
- <sup>93</sup> Linnaeus (1758: 170) under *Turdus crinitus*; the only reference cited.
- <sup>94</sup> Linnaeus (1753: 1030); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 52. 1730, designated by Fernald (1944: 38).
- <sup>95</sup> Linnaeus (1753: 623) under *Bignonia sempervirens* (syntype); lectotype: [icon.] Plukenet, Almagest. Bot.: 359, ad t. 112, f. 5. 1696, designated by Ornduff (1970: 7).
- <sup>96</sup> Linnaeus (1766: 327) under *Muscicapa olivaceus*; three references and two images.
- <sup>97</sup> Linnaeus (1767: 509 & 105) under *Hopea tinctoria* (syntype); lectotype: Herb. Linn. No. 942.1 (LINN), designated by Howard and Staples (1983: 538).
- <sup>98</sup> Linnaeus (1758: 94) under *Lanius tyrannus*; two references and two images.
- <sup>99</sup> Linnaeus (1753: 259) under *Laurus sassafras* (syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 518.21 (LINN), designated by Reveal (2009: 301).
- <sup>100</sup> Linnaeus (1758: 181) under *Fringilla rubra*; the only reference cited.
- <sup>101</sup> Linnaeus (1753: 999; syntype); lectotype: Herb. Linn. No. 1133.5 (LINN), designated by Reveal (2009: 301).
- <sup>102</sup> Linnaeus (1766: 340) under *Parus bicolor*; two references and two images.
- <sup>103</sup> Linnaeus (1753: 151) under *Azalea viscosa* (syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 215.4 (LINN), designated by Kron (1993: 329).
- <sup>104</sup> Linnaeus (1766: 342) under *Parus virginianus*, a synonym; two references and one image.
- <sup>105</sup> Linnaeus (1763: 1346) under *Arethusa divaricata* (syntype); lectotype: *Clayton 635*, Herb. Linn. No. 1059.3 (LINN), designated by Catling and Gregg (1992: 70).
- <sup>106</sup> Reichenbach (1853: 253) under *Certhiola bahamensis*; the only reference cited.
- <sup>107</sup> Jacquin (1797: 37) under *Gardenia clusifolia* (syntype); no lectotype designated.
- <sup>108</sup> Linnaeus (1753: 1058; syntype); lectotype: *Clayton s.n.* (BM-Clayton), designated by Reveal (1992: 470).
- <sup>109</sup> Linnaeus (1766: 187) under *Certhia pinus*; three references and two images. The name (due the citation of Edwards by Linnaeus) was long misapplied to the blue-winged warbler now known as *Vermivora cyanopectus* Olson & Reveal (2009).
- <sup>110</sup> Linnaeus (1753: 1055; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 1225.7 (LINN), designated by Murray (1981: 6).
- <sup>111</sup> Linnaeus (1753: 370) under *Laurus borbonica* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 63. 1731, designated by Kopp (1966: 44).
- <sup>112</sup> Linnaeus (1758: 190) under *Parus americanus*; the only reference cited.
- <sup>113</sup> Linnaeus (1759: 1044) under *Halestia carolina* (syntype); lectotype: [icon.] Stephen Hales commemorative plate by G.D. Ehret, designated by Reveal and Seldin (1976: 133). Neotype of *H. tetraptera*: Reveal & Seldin 3832 (BM).
- <sup>114</sup> Linnaeus (1758: 120) under *Trochilus colubris*; two references and images.
- <sup>115</sup> Linnaeus (1753: 624) under *Bignonia radicans*; lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 65. 1731, designated by Dandy (1958: 112).
- <sup>116</sup> Linnaeus (1766: 328) under *Muscicapa carolinensis*; two references and one image.
- <sup>117</sup> Linnaeus (1753: 176; syntype); lectotype: Herb. Linn. No. 567.1 (LINN), designated by Sleumer (1967: 75).

- <sup>118</sup> Linnaeus (1758: 186) under *Motacilla ruticilla*; four references and three images.
- <sup>119</sup> Linnaeus (1753: 997; syntype); lectotype: Herb. Linn. No. 1129.5 (LINN), designated by Reveal et al. (1987: 226).
- <sup>120</sup> Linnaeus (1758: 175) under *Loxia nigra*; two references and images.
- <sup>121</sup> Linnaeus (1753: 8; syntype); lectotype: Herb. Linn. No. 21.1 (LINN), designated by Reveal (in Jarvis et al. 1993: 33).
- <sup>122</sup> Linnaeus (1758: 115) under *Alcedo alcyon*; two references and three images.
- <sup>123</sup> Linnaeus (1753: 1024) under *Myrica cerifera* (syntype); lectotype: *Clayton 692* (BM-Clayton), designated by Parra-Osorio (2001: 136).
- <sup>124</sup> Linnaeus (1758: 153) under *Rallus carolinus*; two references and images. Linnaeus (1766: 263) under *Rallus virginianus*, a synonym; two references and one image.
- <sup>125</sup> Linnaeus (1753: 288) under *Gentiana saponaria* (syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 328.8 (LINN), designated by Pringle (1967: 2). Neotype of *G. catesbaei* is folio 50 (BM-Walter), designated by Fernald (1947: 176).
- <sup>126</sup> Linnaeus (1758: 150); the only reference cited.
- <sup>127</sup> Linnaeus (1753: 394) under *Andromeda arborea* (syntype); lectotype: *Clayton 613* (BM-Clayton), designated by Vander Kloet (in Cafferty and Jarvis, 2003: 752).
- <sup>128</sup> Linnaeus (1758: 139); numerous references and images.
- <sup>129</sup> Linnaeus (1758: 139); numerous references and images.
- <sup>130</sup> Linnaeus (1758: 142) under *Ardea americana*; two references and images.
- <sup>131</sup> Linnaeus (1758: 143) under *Ardea caerulea*; five references and three images.
- <sup>132</sup> Linnaeus (1763: 971) under *Malva abutiloides*; lectotype: [icon.] Dillenius, Hort. Eltham. 1: t. 1. 1732, designated by Reveal (2009: 310).
- <sup>133</sup> Linnaeus (1758: 143) under *Ardea violacea*; the only reference cited.
- <sup>134</sup> Linnaeus (1753: 929) under *Lobelia phumieri* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 79. 1731, designated by Jeffrey (1980: 543).
- <sup>135</sup> Linnaeus (1758: 144) under *Ardea virescens*; three references and images.
- <sup>136</sup> Linnaeus (1753: 1057) under *Fraxinus americana* (syntype); lectotype: Herb. Linn. No. 1230.3 (LINN), designated by Fernald (1946: 391). Miller (1768: *Fraxinus*, no. 6) proposed *F. caroliniana*; Neotype: [icon.] Catesby, Nat. Hist. Carolina 1: t. 80. 1731, designated by Reveal (2009: 311).
- <sup>137</sup> Linnaeus (1758: 140) under *Tantalus loculator*, a synonym; three references and one image.
- <sup>138</sup> Linnaeus (1758: 145) under *Scolopax alba*; the only reference cited.
- <sup>139</sup> Linnaeus (1758: 145) under *Scolopax fusca*, a synonym; the only reference cited.
- <sup>140</sup> Linnaeus (1758: 145) under *Scolopax rubra*; six references and three images.
- <sup>141</sup> Linnaeus (1758: 152) under *Haematopus ostralegus*; eight references and four images.
- <sup>142</sup> Linnaeus (1758: 134) under *Pelecanus piscator*; six references and two images.
- <sup>143</sup> Linnaeus (1758: 137) under *Sterna stolidus*; four references and two images.
- <sup>144</sup> Linnaeus (1758: 136); the only reference cited.
- <sup>145</sup> Linnaeus (1758: 138); three references and one image.
- <sup>146</sup> Linnaeus (1758: 136) under *Colymbus podiceps*; the only reference cited.
- <sup>147</sup> Linnaeus (1758: 123) under *Anas canadensis*; four references and five images.
- <sup>148</sup> Linnaeus (1758: 124); the only reference cited.
- <sup>149</sup> Linnaeus (1759: 1227) under *Buphthalmum arborescens* (syntype); lectotype: *Clayton 242* (BM-Clayton), designated by Reveal (in Jarvis and Turland, 1998: 355).
- <sup>150</sup> Linnaeus (1758: 129) under *Mergus cucullatus*; the only reference cited.
- <sup>151</sup> Linnaeus (1758: 125) under *Anas bucephala*; the only reference cited.
- <sup>152</sup> Linnaeus (1758: 128) under *Anas sponsa*; three references and two images.
- <sup>153</sup> Linnaeus (1758: 125) under *Anas rustica*, a synonym; the only reference cited.
- <sup>154</sup> Linnaeus (1766: 205) under *Anas discors* ♀; two references and one image.
- <sup>155</sup> Linnaeus (1766: 205); three references and one image.

- <sup>156</sup> Edwards, 1771[2]: 1); the only reference cited.
- <sup>157</sup> Linnaeus (1758: 313) under *Esax vulpes*; the only reference cited.
- <sup>158</sup> Linnaeus (1766: 485) under *Perca chrysoptera*; two references and one image.
- <sup>159</sup> Linnaeus (1766: 513) under *Salmo foetens*; two references and one image.
- <sup>160</sup> Linnaeus (1766: 483) under *Perca undulata*; two references and one image.
- <sup>161</sup> Walbaum (1792: 351) under *Perca rufus*; the only reference cited.
- <sup>162</sup> Linnaeus (1766: 470) under *Sparus rhomboides*; two references and one image.
- <sup>163</sup> Linnaeus (1758: 292) under *Perca venenosa*; the only reference cited.
- <sup>164</sup> Linnaeus (1766: 488) under *Perca formosa*; two references and one image.
- <sup>165</sup> Linnaeus (1766: 520) under *Mugil albula*; three references and one image.
- <sup>166</sup> Linnaeus (1758: 291) under *Perca punctata*, a synonym; the only reference cited.
- <sup>167</sup> Linnaeus (1758: 292) under *Perca melamura*; the only reference cited.
- <sup>168</sup> Linnaeus (1758: 293) under *Perca saltatrix*; the only reference cited. Linnaeus (1766: 486) under *Perca sectatrix* “corrected” the spelling, the epithet used by Catesby, although “*K. spectator*” is often used.
- <sup>169</sup> Cuvier (1829: 147) under *Pomotis vulgaris*, a synonym; the only reference cited.
- <sup>170</sup> Linnaeus (1758: 283) under *Labrus griseus*; the only reference cited.
- <sup>171</sup> Linnaeus (1766: 507) under *Teuthis hepatus*; five references and three images.
- <sup>172</sup> Linnaeus (1758: 287) under *Labrus fulvus*; the only reference cited.
- <sup>173</sup> Walbaum (1792: 228) under *Mugil cinereus*; three references and one image.
- <sup>174</sup> Linnaeus (1758: 284) under *Labrus rufus*; the only reference cited.
- <sup>175</sup> Linnaeus (1758: 288) under *Labrus radiatus*; the only reference cited.
- <sup>176</sup> Linnaeus (1766: 482) under *Perca alburnus*; two references and one image.
- <sup>177</sup> Linnaeus (1758: 292) under *Serranus guttatus*; five references and three images.
- <sup>178</sup> Linnaeus (1766: 491) under *Gasterosteus saltatrix*; two references and one image.
- <sup>179</sup> Walbaum (1792: 261) under *Labrus maximus*; the only reference cited. Cuvier (1829: 257) under *Lachnolaimus sulius*, a synonym; the only reference cited.
- <sup>180</sup> Linnaeus (1766: 471) under *Sparus chrysops*; two references and one image.
- <sup>181</sup> Linnaeus (1858: 280) under *Sparus synagris*; the only reference cited.
- <sup>182</sup> Linnaeus (1758: 312); five references and three images.
- <sup>183</sup> Edwards (1771(2): 1) under *Coryphaena coerulea*; the only reference cited.
- <sup>184</sup> Linnaeus (1758: 327) under *Balistes monoceros*; three references and one image.
- <sup>185</sup> Linnaeus (1758: 244) under *Muraena helena*; five references and three images.
- <sup>186</sup> Cuvier (1829: 352) under *Muraena moringa*; the only reference cited.
- <sup>187</sup> Linnaeus (1758: 801) under *Gorgonia ceratophyta*; four references and three images.
- <sup>188</sup> Linnaeus (1758: 329); four references and two images.
- <sup>189</sup> Linnaeus (1758: 305), under *Silurus catus*; two references and one image.
- <sup>190</sup> Linnaeus (1766: 519) under *Argentina carolina*, a synonym; two references and one image.
- <sup>191</sup> Linnaeus (1758: 282) under *Labrus anthias*; two references and one image.
- <sup>192</sup> Linnaeus (1758: 260) under *Echenets remora*; four references and three images.
- <sup>193</sup> Linnaeus (1753: 981; syntype); lectotype: Hort. Clifford 439.1 (BM-Clifford), designated by Webster (1956: 2).
- <sup>194</sup> Linnaeus (1758: 269) under *Pleuronectes lunatus*; the only reference cited.
- <sup>195</sup> Michaux (1803: 244) under *Laurus catesbyana* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 28. 1734, designated by Howard and Staples (1983: 528).
- <sup>196</sup> Bonnaterra (1788: 96, pl. 50, fig. 193) under *Scarus viridis*; the only reference cited. Lacepède (1802: 16) under *Scarus catesby*, sometimes cited as “*catesbaei*” or “*catesbyi*”; the only reference cited.
- <sup>197</sup> Linnaeus (1758: 313) under *Esax osseus*; three references and images.
- <sup>198</sup> The identity of this plant continues to be frustrating. In spite of Catesby’s declaration that his plant had 6-merous flowers, 4-merous capsules, and a height of twelve feet, the general feeling of

- most botanists continues to be that this plant is representative of a species of *Hypericum* with the shrubby *H. profligum* L. the most likely candidate. This species occurs within the areas visited by Catesby in both Virginia and South Carolina, but flowering in the winter, as stated by Catesby, is questionable although it is possible he saw some individual flowers at that time.
- <sup>199</sup> Shaw (1803: 325) under *Chaetodon catesbeii*; the only reference cited.
- <sup>200</sup> Linnaeus (1758: 626) under *Cancer ruricola*; four references and two images.
- <sup>201</sup> Linnaeus (1759: 1000; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 33. 1734, designated by Howard (1988: 557).
- <sup>202</sup> Linnaeus (1758: 631) under *Cancer diogenes*; three references and two images.
- <sup>203</sup> Linnaeus (1758: 626) under *Cancer vocans*; two references and images. The earlier *Cancer arenarius* Edwards (1771[2]: 1) is suppressed; also *Ocypoda albicans* Bosc (1802: 196) with an indirect reference to Catesby.
- <sup>204</sup> Linnaeus (1758: 630) under *Cancer grapsus*; two references, two images.
- <sup>205</sup> Linnaeus (1758: 627) under *Cancer graulatus*; two references, one image.
- <sup>206</sup> Edwards (1771[2]: 1) under *Cancer erythropus*; the only reference cited.
- <sup>207</sup> Pallas (1766: 198) under *Gorgonia muricata*; six references and five images.
- <sup>208</sup> Linnaeus (1758: 197) under *Testudo caretta*; four references and two images; see also 2: t. 40.
- <sup>209</sup> Linnaeus (1758: 222) questionably cited under *Coluber nebulatus*; two references and two images.
- <sup>210</sup> Linnaeus (1753" 394) under *Andromeda racemosa* (syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 563.15 (LINN), designated by Howard and Staples (1983: 524).
- <sup>211</sup> Forster (1771b: 364) under *Coluber erythrogaster*; the only reference cited.
- <sup>212</sup> Linnaeus (1753: 1042) under *Clusia cascarilla*, a synonym; lectotype of *C. cascarilla*: [icon.] Catesby, Nat. Hist. Carolina 2: t. 46. 1736, designated by Dandy (1958: 112).
- <sup>213</sup> Linnaeus (1758: 226) under *Coluber mycterizans*; four references and five images.
- <sup>214</sup> Linnaeus (1753: 111; syntype); lectotype: Herb. Linn. No. 136.1 (LINN), designated by Moldenke (1936: 306).
- <sup>215</sup> Linnaeus (1766: 385) under *Coluber constrictor*; two references and one image.
- <sup>216</sup> Linnaeus (1753: 706; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 49. 1736, designated by Reveal (in Jarvis and Turland, 1997: 469).
- <sup>217</sup> Linnaeus (1766: 385) under *Coluber saurita*; two references and one image.
- <sup>218</sup> Linnaeus (1753: 371) under *Laurus winterana* (syntype); lectotype: Herb. Clifford: 488, *Winterana* 1 (BM), designated by Reveal (2009: 324).
- <sup>219</sup> Linnaeus (1766: 385) under *Coluber saurita*; see also footnote 216.
- <sup>220</sup> Linnaeus (1753: 380) under *Caesalpinia brasiliensis* (syntype); lectotype: [icon.] Plumier, "Caesalpinia polyphylla, aculeis horrida," Codex Boerhaavianus, Groningen University Library, Rijksuniversiteit, Groningen, designated by Lewis and Reveal (in Jarvis et al. 1993: 28).
- <sup>221</sup> Linnaeus (1766: 382) under *Coluber getulus*; two references and one image.
- <sup>222</sup> Linnaeus (1766: 379) under *Coluber ordinatus*, a synonym; four references and two images.
- <sup>223</sup> Linnaeus (1756: 12) under *Vinca lutea* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 53. 1736, designated by Dandy (1958: 112).
- <sup>224</sup> Shaw (1802: 475) under *Coluber flagellum*; the only reference cited.
- <sup>225</sup> Linnaeus (1766: 373) under *Boa conortrix*; three references and two images.
- <sup>226</sup> Linnaeus (1762: 434; syntype); lectotype: [icon.] Trew, Pl. Select.: t. 11. 1751, designated by Reveal (in Jarvis 2007: 633).
- <sup>227</sup> Linnaeus (1766: 387) under *Coluber aestivus*; two references and one image.
- <sup>228</sup> Linnaeus (1753: 125) under *Ilex cassine* var. *β*.
- <sup>229</sup> Linnaeus (1766: 378) questionably cited under *Coluber fasciatus*; two references and one image.
- <sup>230</sup> Linnaeus (1766: 391) under *Anguis ventralis*; two references and one image.
- <sup>231</sup> Linnaeus (1766: 385) questionably cited under *Coluber guttatus*; two references and one image.

- <sup>232</sup> Linnaeus (1753: 154) under *Convolvulus batatas* (syntype); lectotype: Herb. Linn. No. 77.5 (S), designated by Bijl (2002: 755); also lectotype of *Ipomoea catesbaei* G.F.W. Mey. (1818: 103), designated by Reveal (2009: 331).
- <sup>233</sup> Linnaeus (1759: 1082; syntype); lectotype: [icon.] Miller, Fig. Pl. Gard. Dict. 2: t. 172. 1757, designated by Vázquez-G. (1994: 5); also lectotype of *Magnolia virginiana* var. *foetida* (Linnaeus 1753: 536), designated by Reveal (2009: 331).
- <sup>234</sup> Linnaeus (1758: 44) under *Viverra putorius*; two references and one image.
- <sup>235</sup> Linnaeus (1758: 200) under *Lacerta crocodilus*; numerous references and images.
- <sup>236</sup> Linnaeus (1758: 206) questionably cited under *Lacerta iguana*; numerous references and images. Indirectly cited by Cuvier (1829: 45) under *Iguana cythlura*.
- <sup>237</sup> Linnaeus (1753: 537; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 64. 1738, designated by Dandy (1958: 112).
- <sup>238</sup> Voigt (1832: 71) translated a Cuvier (1829: 50) phrase in French into a Latin binomial wherein Catesby is cited in error (t. 66 instead of t. 65); the only reference cited.
- <sup>239</sup> Linnaeus (1753: 999; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 1134.1 (LINN), designated by Wijnands (1983: 109).
- <sup>240</sup> Linnaeus (1758: 208) under *Lacerta bullaris*, a suppressed name; the only reference cited.
- <sup>241</sup> Linnaeus (1753: 384; syntype); lectotype: Herb. Linn. No. 538.1 (LINN), designated by Howard and Staples (1983: 529).
- <sup>242</sup> Linnaeus (1758: 209) under *Lacerta fasciata*; the only reference cited. Later cited under *Plestiodon quinquelineatus* var. *β. Lacerta quinquelineatus* Linnaeus (1766: 366) is a synonym; the only reference cited.
- <sup>243</sup> Linnaeus (1753: 537; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 67. 1738, designated by Dandy (1958: 112).
- <sup>244</sup> Linnaeus (1766: 364) under *Lacerta sxdineata* (as “6-lineata”); two references and one image.
- <sup>245</sup> Bonnaterra (1789: 8) under *Rana terrestris*; the only reference cited.
- <sup>246</sup> Elliott (1821: 11) under *Sarrocenia × minor* (*pro sp.*, syntype).
- <sup>247</sup> Linnaeus (1753: 510; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2, t. 69. 1738, designated by McDaniel (1971: 15).
- <sup>248</sup> Linnaeus (1753: 510; syntype); conserved type: *Baldwin & Bretting 2910* (K), designated by Cheek et al. (1997: 781).
- <sup>249</sup> Shaw (1802: 136) under *Rana bilineata*, a synonym; the only reference cited.
- <sup>250</sup> Hentz (1832: 106), under *Sphasus viridans*, made no reference to Catesby. Until now this spider has not been identified.
- <sup>251</sup> Linnaeus (1766: 356) under *Rana ocellata*; five references and four images, see Lavilla et al. (2010).
- <sup>252</sup> Linnaeus (1753: 951) under *Cypripedium calceolus* var. *γ*; lectotype of *C. vittatum* Vell. var. *platum* Raf. (1833: 44) is [icon.] Catesby, Nat. Hist. Carolina 2: t. 72. 1738, designated by Howard and Staples (1983: 516).
- <sup>253</sup> Linnaeus (1758: 64); the only reference cited.
- <sup>254</sup> Linnaeus (1753: 951) under *Cypripedium calceolus* var. *β*; lectotype of *C. vittatum* Vell. var. *tortile* Raf. (1833: 44) is [icon.] Catesby, Nat. Hist. Carolina 2: t. 73. 1738, designated by Howard and Staples (1983: 516).
- <sup>255</sup> Linnaeus (1758: 64) under *Scnurus cinereus*; three references and one image.
- <sup>256</sup> Linnaeus (1758: 64) under *Scnurus striatus*; four references and two images.
- <sup>257</sup> Linnaeus (1758: 64) under *Scnurus volans*; seven references and three images.
- <sup>258</sup> Linnaeus (1753: 1057; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 1231.4 (LINN), designated by Reveal (in Jarvis 2007: 482).
- <sup>259</sup> Linnaeus (1758: 64) under *Scnurus volans*; seven references and three images.
- <sup>260</sup> Schreber (1778: 361, 585, pl. 92B) under *Canis virginianus*, a synonym (Wozencraft 2005: 582); the only reference cited. The Schreber image, drawn by Nufsbiegel and engraved by Kretsch,

- is a near copy of Catesby's own illustration. Catesby is briefly mentioned by Schreber (1776: 361) under another name, a taxon now known as *C. cinereoargenteus* Schreber (1776: 360, 585 [as "argenteus"], pl. 92 [as *cinereo argenteus*]). The full citation on the plate, "*Canis cinereo argenteus* Briss.", was taken from from Brisson (1756: 241) who actually wrote "*Canis ex cinereus argenteus*" as a phrase name, his binomial being *Vulpes cinerea*. It is likely that the correct epithet for the gray fox, unless conserved, should be *argenteus* not *cinereoargenteus*.
- <sup>261</sup> Linnaeus (1753: 175) under *Lonicera marilandica* (syntype); lectotype: Clayton s.n. (BM-Clayton), designated by Reveal et al. (1987: 230).
- <sup>262</sup> Linnaeus (1759: 936) under *Cordia bournieria* (syntype); lectotype *P. Browne s.n.*, Herb. Linn. No. 254.2 (LINN), designated by Stearn (1971: 620).
- <sup>263</sup> Linnaeus (1753: 536; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 80. 1738, designated by Dandy (1958: 112).
- <sup>264</sup> Linnaeus (1759: 940) under *Cedrela mahag[oni]* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 81. 1743, designated by Dandy (1958: 112).
- <sup>265</sup> Linnaeus (1753: 1023) under *Viscum rubrum* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 81. 1743, designated by Dandy (1958: 112).
- <sup>266</sup> Linnaeus (1758: 463) under *Papilio antiochus*, a synonym; two references and two images.
- <sup>267</sup> Linnaeus (1758: 496) under *Phalaena luna*; three references and two images.
- <sup>268</sup> Linnaeus (1753: 470; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 84. 1743, designated by Dandy (1958: 112).
- <sup>269</sup> Reveal and Jarvis (2009: 981) lectotypified *Smilax lanceolata* L. on the Plukenet (1691: t. 110, f. 4) plate cited by Linnaeus unaware of the existence of a second original element, a mislabeled sheet in the Clifford herbarium (Herb. Clifford: 459, *Smilax* no. 2B; Acosta and Greuter 2010: 287). The Linnaean name is a synonym of *S. tamnoides* L.
- <sup>270</sup> Linnaeus (1753: 537) under *Annona triloba* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 85. 1743, designated by Dandy (1958: 112).
- <sup>271</sup> Linnaeus (1758: 496) under *Phalaena cecropia*; the only reference cited.
- <sup>272</sup> Linnaeus (1753: 512) under *Sloanea emarginata* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 87. 1743, designated by Dandy (1958: 112).
- <sup>273</sup> Linnaeus (1758: 471) under *Papilio plexippus*; four references and five images.
- <sup>274</sup> Linnaeus (1763: 1351) under *Epidendrum cochleatum* (syntype); lectotype: [icon.] Plumier in Burman, Pl. Amer.: t. 185, fig. 2. 1758, designated by Garay and Sweet in R.A. Howard (1974: 163).
- <sup>275</sup> Linnaeus (1758: 433) under *Gryllus carolinus*; the only reference cited.
- <sup>276</sup> Linnaeus (1753: 286) questionably cited under *Renealmia polystachia* (syntype).
- <sup>277</sup> Linnaeus (1758: 496) questionably cited under *Phalaena paphia*; two references and two images.
- <sup>278</sup> Linnaeus (1753: 190; syntype); lectotype: [icon.] Sloane, Voy. Jamaica 2: t. 164. 1725, designated by J.S. Miller in Cafferty and Jarvis (2004: 801).
- <sup>279</sup> Linnaeus (1753: 160; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 91. 1743, designated by Dandy (1958: 112).
- <sup>280</sup> Linnaeus (1753: 209; syntype); lectotype: [icon.] Sloane, Voy. Jamaica 2: t. 185, f. 1. 1725, designated by Wijnands (1983: 44).
- <sup>281</sup> Linnaeus (1753: 209; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 93. 1743, designated by Dandy (1958: 112).
- <sup>282</sup> Linnaeus (1753: 995; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 93. 1743, designated by Reveal (2009: 351).
- <sup>283</sup> Edwards (1771[2]:2) under *Eruca maximacornuta*, a suppressed name; the only reference cited.
- <sup>284</sup> Linnaeus (1758: 480) under *Papilio rumina*; the only reference cited.
- <sup>285</sup> Linnaeus (1753: 1191; syntype); lectotype: [icon.] Sloane, Voy. Jamaica 2: t. 159. 1725, designated by Wijnands (1983: 103).

- <sup>286</sup> Linnaeus (1753: 1023) under *Viscum purpureum* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 95, 1743, designated by Dandy (1958: 112).
- <sup>287</sup> Linnaeus (1758: 534) under *Phalaena bella*; three references and images.
- <sup>288</sup> Linnaeus (1753: 365) under *Polygonum uvifera* (syntype); lectotype: Herb. Linn. No. 511.1 (LINN), designated by Brandbyge (1989: 39).
- <sup>289</sup> Linnaeus (1753: 391; syntype); lectotype: [icon.] Plukenet, Amalth. Bot.: t. 379, f. 6. 1705, designated by Reveal (in Jarvis et al. 1993: 58).
- <sup>290</sup> Jacquin (1760: 34; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2: t. 99, 1743, designated by D'Arcy (1981: 986).
- <sup>291</sup> Cramer (1777: 4, t. 98, f. F, G) under *Papilio marcellus*, a questionable validly established binomial.
- <sup>292</sup> Linnaeus (1753: 109; syntype); lectotype: Catesby, Nat. Hist. Carolina 2: t. 100, 1743, designated by Dandy (1958: 112).
- <sup>293</sup> Linnaeus (1758: 160) under *Tetrao cupido*; two references and images.
- <sup>294</sup> Linnaeus (1753: 144) under *Dodecatheon media* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 1. 1747, designated by Dandy (1958: 112).
- <sup>295</sup> Linnaeus (1753: 124; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 169.1 (LINN), designated by Reveal (in Jarvis et al. 1993: 52).
- <sup>296</sup> Linnaeus (1758: 105); six references and four images.
- <sup>297</sup> Rafinesque (1833: 44) under *Cypripedium catesbianum* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 3. 1747, designated by Howard and Staples (1983: 516).
- <sup>298</sup> Linnaeus (1758: 108) under *Coracias xanthormus*, in error; three references and two images. Linnaeus (1766: 161) under *Oriolus icterus*; nine references and eight images.
- <sup>299</sup> Linnaeus (1767: 941) questionably cited under *Sphex caerulea*, a later homonym; two references and images.
- <sup>300</sup> Linnaeus (1753: 291) under *Pancreatum carolinianum* (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 5. 1747, designated by Dandy (1958: 112).
- <sup>301</sup> Linnaeus (1753: 782; syntype); lectotype: [icon.] Sloane, Voy. Jamaica 2: t. 160, 1725, designated by Dorr (in Jarvis et al. 1993: 93).
- <sup>302</sup> Miller (1768: *Vanilla* no. 1; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 7. 1747, designated by Reveal (2009: 359).
- <sup>303</sup> Linnaeus (1758: 192) under *Hirundo pelagica*; the only reference cited.
- <sup>304</sup> Linnaeus (1753: 383; syntype); lectotype: Herb. Hermann 3: 50, No. 165 (BM), designated by Fawcett and Rendle (1926: 6).
- <sup>305</sup> Linnaeus (1758: 143), questionable cited; two references and two images.
- <sup>306</sup> Linnaeus (1766: 370) under *Lacerta punctata*, a homonym, non Linnaeus (1758: 209); the only reference cited. Shaw (1802: 304); the only reference cited.
- <sup>307</sup> Stoll (1787: 177) under *Phalcaena scribonia* without any direct reference to Catesby; also known as *Ecpantheria scribonia*.
- <sup>308</sup> Linnaeus (1758: 614) under *Pulex penetrans*; three references and one image.
- <sup>309</sup> Linnaeus (1758: 349) under *Scarabaeus pilularius*; four references and images.
- <sup>310</sup> Linnaeus (1758: 249) apparently under *Scarabaeus pilularius*, see footnote 305.
- <sup>311</sup> Linnaeus (1753: 303; syntype); lectotype: Herb. Linn. No. 420.6 (LINN), designated by Adams and Dress (1982: 172).
- <sup>312</sup> Linnaeus (1758: 161) under *Tetrao virginianus*; the only reference cited.
- <sup>313</sup> Linnaeus (1753: 292) under *Amaryllis atamasca* (syntype); lectotype: Hort. Clifford 135.4 (BM-Clifford), designated by Reveal (in Jarvis 2007: 284).
- <sup>314</sup> Linnaeus (1758: 188) under *Motacilla regulus*; seven references and six images. Linnaeus (1766: 337) described *M. calandula* from Pennsylvania but maintained the Catesby reference under *M. regulus*.



- <sup>315</sup> Linnaeus (1753: 698; syntype); lectotype: *Clayton 734*, Herb. Linn. No. 876.1 (LINN), designated by Spongberg (1974: 194).
- <sup>316</sup> Linnaeus (1758: 134); seven references and five images.
- <sup>317</sup> Linnaeus (1758: 131) under *Procclaria pelagica*; nine references and four images.
- <sup>318</sup> Linnaeus (1758: 582) under *Mutilla occidentalis*; two references and images.
- <sup>319</sup> Linnaeus (1753: 536) under *Magnolia virginiana* L. var. *acuminata* L. (syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 15, excluding the flower, designated by Dandy (1958: 112).
- <sup>320</sup> Linnaeus (1758: 193) under an unnamed variety of *Caprimulgus europaeus*; two references and images. Forster (1771a: 13) under *Caprimulgus minor*; the only reference cited.
- <sup>321</sup> Linnaeus (1753: 1058; syntype); lectotype: *Kalm s.n.*, Herb. Linn. No. 1237.1 (LINN), designated by Reveal (1991: 473).
- <sup>322</sup> Linnaeus (1753: 391; syntype); lectotype: Herb. Linn. No. 560.2 (LINN), designated by Southall and Hardin (1974: 18) with a second lectotypification by Ebinger (1974: 367).
- <sup>323</sup> Linnaeus (1753: 392; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 17. 1747, designated by Chamberlain (in Cafferty and Jarvis 2003: 753).
- <sup>324</sup> Linnaeus (1758: 59) under *Mus leporinus*; the only reference cited.
- <sup>325</sup> Miller (1768: *Ficus* no. 10; syntype); lectotype: [icon.] Catesby, Nat. Hist. Carolina 2App.: t. 18. 1747, designated by Reveal (2009: 364).
- <sup>326</sup> Linnaeus (1758: 307) under *Sihurus cataphractus*; two references and images.
- <sup>327</sup> Linnaeus (1758: 72) under *Bos bison*; seven references and three images.

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- Inseln, beschrieben in ihren natürlichen farben vorgestellt herausgegeben von Nicolaus Friedrich Eisenberger und Georg Lichtensteger. J.J. Gleichmann, Nürnberg.
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## **SPOROBOLUS JUNCEUS (POACEAE) IN OKLAHOMA**

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### **ABSTRACT**

*Sporobolus junceus*, Piney Woods dropseed, a native of the contiguous southeastern states from Virginia to Texas, has been discovered in Oklahoma in sandhills bordering the Harrison/Doshier Bog in Pushmataha County.

**Key Words:** Poaceae, *Sporobolus*, Oklahoma, oak-pine savanna, sandhills

A cosmopolitan genus of at least 160 species, *Sporobolus* is widely distributed in warm-temperate, sub-tropical, and tropical habitats (Clayton & Renvoize 1986). Seventy three species are native to the Western Hemisphere (Peterson et al. 2003), with 27 species native to the United States (Peterson et al. 1997).

Fourteen species of *Sporobolus* (sensu latu) are documented as occurring in Oklahoma (McGregor & Barkley 1977, 1986; Oklahoma Biological Survey 2012; USDA/NRCS 2012). The discovery of a 15<sup>th</sup> species is reported here. Studies on the flora of sandy prairies and sandhill bogs in Pushmataha County have resulted in the collection of *Sporobolus junceus* (P. Beauv.) Kunth.

Voucher specimen: OKLAHOMA. Pushmataha Co.: Sandhill above Harrison/Doshier Bog, 5.16 miles W (at 266°) from Antlers; 34° 13' 34.33" N, 95° 42' 34.60" W; deep sandhills, 13 August 2006, J.R. Singhurst and E. Bridges 14408 (BAYLU). Figs. 1&2.

The sandhills surrounding Harrison and Doshier bogs contains sandy land graminoid and herbaceous species such as *Aristida desmantha*, *Triplasis purpurea*, *Premieranthus rugospermus*, *Paronychia drummondii*, *Stillingia sylvatica* subsp. *sylvatica*, *Dalea phleoides* var. *microphylla*, *Evax candida*, *Eragrostis secundiflora*, *Croptilon divaricatum*, *Hypericum drummondii*, *Chamaecrista fasciculata*, *Cnidioscolus texanus*, *Froelichia floridana*, *Pediomechum* sp., *Scutellaria cardiophylla*, and *Matelea cynanchoides*, found in association with *Sporobolus junceus*.

*Sporobolus junceus* is distributed in the lower Atlantic and Gulf coastal plains from Virginia and Tennessee to Florida and west to eastern Texas and Arkansas (Peterson, Hatch, & Weakley 2003; USDA, NRCS 2012). It is native and occurs in openings of hardwood forests, sandy prairies, pine

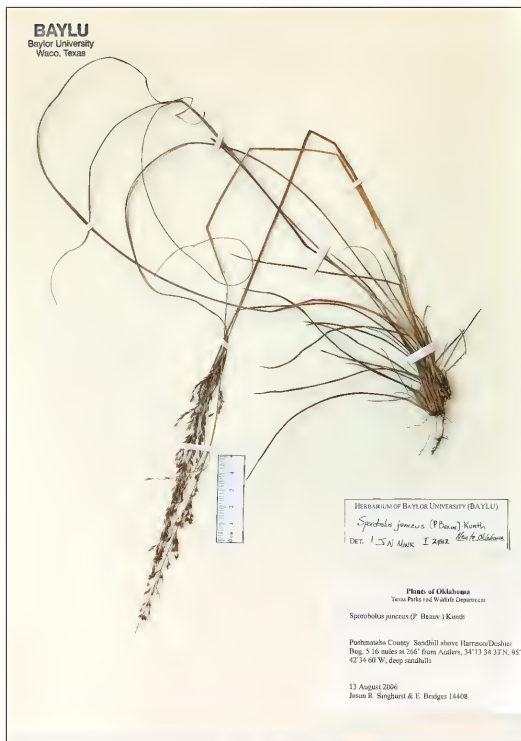


Figure 1. *Sporobolus junceus*. Pushmataha Co, Oklahoma (Singhurst & Bridges 14408, BAYLU)



Figure 2. Close-up of *Sporobolus juncus* panicle (Singhurst & Bridges 14408, BAYLU).

barrens, and savannas within its distribution. The Oklahoma locality is isolated from several known distributions in other states. Within Texas, *S. junceus* is known from coastal prairie areas and interspersed in scattered locations throughout east Texas. The nearest site to the Pushmataha Co., Oklahoma, collection is Upsur Co., Texas (Turner et al 2003) approximately 155 km south. A Louisiana collection from Caddo Parish (Allen 1992) is about 190 km southeast of the Pushmataha Co. record. Locations in Bradley Co. and Drew Co., Arkansas, are about 330 km distant from the Oklahoma location.

Among the Oklahoma *Sporobolus* both *S. cryptandrus* and *S. pyramidatus* appear similar to *S. junceus*. However, *S. junceus* can be distinguished from the other species by a whorled panicle (3 or more branches per lower node), long spikelets (>2.5mm) and lack of tufted sheath apex (see Figs. 1&2). *Sporobolus cryptandrus* lacks a whorled panicle, has distinct white tufts of trichomes at the distal part of the sheath and shorter spikelets (<2.5 mm). *Sporobolus pyramidatus* has a distinctly whorled (5 or more branches per lower node) pyramidal-shaped panicle, lacks a distinct tuft of trichomes at the sheath apex and shorter spikelets (<2.5 mm).

#### ACKNOWLEDGEMENTS

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## NEW TO OKLAHOMA: *CAREX COMOSA* (CYPERACEAE)

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### ABSTRACT

This paper documents the occurrence of a vascular plant species previously unknown to the flora of Oklahoma. *Carex comosa*, a perennial sedge, was discovered in a small emergent wetland known as Ferndale Bog in Atoka County of southeastern Oklahoma.

**KEY WORDS:** *Carex comosa*, Cyperaceae, Oklahoma, sedge

*Carex comosa* Boott (Cyperaceae, sect. Vesicariae; longhair sedge) is a perennial sedge. The species has been reported from much of the North American continent north of Mexico but is uncommon in the unglaciated South and in the West (Ball & Reznicek 2002). Populations have been found in neighboring states of Arkansas, Missouri, and Texas (BONAP 2012; USDA, NRCS 2012) but a collection reported here is the first for Oklahoma (Hoagland et al. 2012).

**Oklahoma.** Atoka Co.: McGee Creek Natural Scenic Recreation Area, “Ferndale” Bog, 15S 242185 3810626, T25S R14E Sec. 2, 6 May 2008, Buthod & Hoagland AB-7776 (OKL 239346a). Figs. 1, 2.

The Oklahoma collection was found at a site known as Ferndale Bog in Atoka County in southeastern Oklahoma. The habitat is considered unique in the state and was cored for palynological research in the 1970s. The substrate consists of generations of sphagnum growing near a spring on a Ouachita Mountain sandstone ridge (Albert 1981). The site is dominated by a 1.5+ meter tall growth of *Osmunda cinnamomea* (cinnamon fern) and *O. regalis* (royal fern) (Fig. 3). Other associated species included *Boehmeria cylindrica*, *Carex lupulina*, and *Carex stricta*.

### ACKNOWLEDGEMENTS

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USDA, NRCS, 2012 The PLANTS Database National Plant Data Team, Greensboro, North Carolina <<http://plants.usda.gov>> Accessed Jan 2012



Figure 1. *Carex comosa* from Femdale Bog in Atoka Co., Oklahoma Buthod & Hoagland AB-7776 (OKL)



Figure 2. Spikelet of *Carex comosa* (Hoagland & Buthod AB-7776).



Figure 3. Aspect of Ferndale Bog with *Osmunda cinnamomea* in foreground.

## ON THE VALIDATION OF *CHORIZANTHE* AND *MUCRONEA* (POLYGONACEAE: ERIOGONEAE)

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### ABSTRACT

Traditionally *Chorizanthe* R. Br. ex Benth. and *Mucronea* Benth. (Polygonaceae: Eriogoneae) were considered to have been published in the third part of volume 17 of the Transactions of the Linnean Society sometime between 21 June and 9 July 1836. In fact, both names were validly published earlier, initially in May of 1835 in the London and Edinburgh Philosophical Magazine and Journal of Science, and again on 7 June 1836 in the journal Flora. No species were assigned to either genus until Bentham's paper on Eriogoneae was published in mid-1836.

**KEY WORDS:** nomenclature, George Bentham, Transactions of the Linnean Society, London and Edinburgh Philosophical Magazine

While assembling a new and updated bibliography on Polygonaceae Juss. trib. Eriogoneae Dumort., it was discovered that *Chorizanthe* R. Br. ex Benth. and *Mucronea* Benth. were validated in a review of the 7 April 1835 meeting of the Linnean Society of London (Brewster et al. 1835) in which George Bentham presented a paper entitled "On the Eriogoneae, a tribe of the order Polygonaceae." As may be seen from the dates given on the first page of individual signatures as well as the subsequently published table of contents, this notice was published in the May 1835 issue (pages 321–400) of the London and Edinburgh Philosophical Magazine and Journal of Science, or about a month after the meeting. On page 379 the following appears in part of that review:

The group [Eriogoneae] consists of three genera, namely, *Eriogonum* distinguished by its many-flowered involucre, *Chorizanthe*, a genus proposed by Mr. Brown, and distinguished from the former by having a single-flowered involucre, and lastly, *Mucronea*, characterized by its bidentate involucre, composed of two confluent bracts

This same notice was reproduced almost word-for-word later (Beilschmied 1836) in the journal Flora (19: 332. 7 Jun 1836):

Diese Gruppe [Eriogoneae] besteht aus 3 Gattungen: *Eriogonum*, durch vielbluthige Hülle ausgezeichnet, *Chorizanthe* R.Br., n.g., deren nur einblüthiges Involucrum sie von *Eriogonum* unterscheidet, und *Mucronea*, welche sich durch ein aus zwei zusammenfließenden Bracteen gebildetes Involucrum bidentatum charakterisirt.

According to Raphael (1970: 75), volume 17, part 3, pp. 315–464, along with plates 10–22, of the Transactions was published sometime between 21 June and 9 July of 1836. Thus Bentham's 1836 paper, long considered the first place of validation for both names (Bentham 1856; Torrey & Gray 1870; Goodman 1934; Reveal & Hardham 1989; Reveal 2005), did not appear until after at least two reviews were published wherein his new genera were validated.

Thus, the correct citation of both names is as follows:



*Chorizanthe* R. Br. ex Benth. in London Edinburgh Philos. Mag. & J. Sci., ser. 3, 6: 379. Mai 1835.  
 L.T.: *Chorizanthe virgata* Benth. in Trans. Linn. Soc. London 17: 416. 1836, designated by  
 Goodman in Ann. Missouri Bot. Gard. 21: 19. 1934.

*Mucronea* Benth. in London Edinburgh Philos. Mag. & J. Sci., ser. 3, 6: 379. Mai 1835. T.:  
*Mucronea californica* Benth. in Trans. Linn. Soc. London 17: 419. 1836.

#### ACKNOWLEDGEMENTS

The development of a bibliography, aided greatly by the advent of searchable, online resources of scientific literature, is part of an effort to prepare an identification manual of Eriogoneae for members of the Eriogonum Society. I wish to thank Kanchi N. Gandhi for his counsel and help with this matter.

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## INFRAGENERIC CLASSIFICATION OF *RHEXIA* (MELASTOMATACEAE)

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### ABSTRACT

An infrageneric classification of *Rhexia* is presented, based primarily on morphology. The 13 species are divided into four sections: (1) Sect. *RHEXIA* (*R. virginica*, the type; 9 species, divided informally into two morphological groups based on stem morphology); (2) Sect. *CYMBORRHEXIA* Nesom, sect. nov. (*R. alifanus*, the type; 1 species); (3) Sect. *BREVIANTHERA* Nesom, sect. nov. (*R. petiolata*, the type; 2 species); and (4) Sect. *LUTEORHEXIA* Nesom, sect. nov. (*R. lutea* the type; 1 species). A diagnostic key to the sections and groups and comments on species delimitations in the *R. mariana* group are provided.

*Rhexia* comprises 13 species (see comments below), all of which are restricted to central and eastern North America (the USA and Canada) except for *R. cubensis*, which also occurs in the West Indies (Cuba, Hispaniola, Puerto Rico). The genus has been the subject of taxonomic studies (James 1956; Kral & Bostick 1969, largely repeating the James study, with addition of a new species and cytological data; Snyder 1996, a regional study) as well as a phylogenetic study (Lonta et al. 2007).

*Rhexia* has sometimes been treated as the monotypic tribe Rhexieae DC. The genus was hypothesized by Renner (1993) to be sister to tribe Meranieae Triana, but a later study (Clausing & Renner 2001) indicated that *Rhexia* is sister to *Arthrostemma* Pavón ex D. Don, a genus comprising seven species of herbaceous perennials native from Mexico and the West Indies to Bolivia in South America. The analysis by Fritsch et al. (2004) placed *Rhexia* and *Arthrostemma* as sister to the primarily Brazilian tribe Microlicieae, but wider sampling (Michelangeli et al. submitted) indicates that a clade that includes these two genera along with *Pachyloma* DC. (ca. 6 species, northern South America) is nested cladistically within the broader group that constitutes tribe Melastomeae.

The present account provides a formal infrageneric classification of *Rhexia*. It arose out of an attempt to understand the patterns of variation within the genus during preparation of a taxonomic treatment for the Flora of North America North of Mexico and the need for a summary of discussions and analyses by previous authors.

### Species delimitations

Species of *Rhexia* recognized here and in the FNA treatment are similar to those of Kral and Bostick (1969) except in one instance. In the concept of Kral and Bostick, *R. mariana* includes the two tetraploid entities var. *ventricosa* and var. *interior* — the geographic ranges of both of the latter lie almost completely within that of the typical expression, which is diploid. Var. *mariana* is completely reproductively isolated from the tetraploid varieties, which form sterile seeds in experimental crosses. Variety *interior* and var. *ventricosa* are morphologically similar to each other but completely allopatric and each differs from var. *mariana* in a prominent feature of stem morphology — typical *R. mariana* has unequal stem faces (see below) while each of the two tetraploids has equal faces. Following James (1956), these two non-typical taxa are recognized here and at specific rank, apart from *R. mariana* in the strict sense. The morphological differences that separate these three entities are consistent and the ploidal differences contribute to the reproductive isolation that has been experimentally documented.

The biological situation is different in *Rhexia cubensis* (diploid, tetraploid, hexaploid), *R. nashii* (tetraploid, hexaploid), and *R. virginica* (diploid, tetraploid), where conspecific plants of different ploidy apparently occur sympatrically and are completely reproductively isolated (no seeds formed in experimental crosses), but there are no obvious morphological differences among them (see chromosome counts, geography, and crossing data in Kral and Bostick).

*Rhexia mariana* var. *exalbida* was formally recognized by James (1956) as distinct in its white flowers and linear leaves and, as mapped (his Fig. 15), centered mostly from southern Mississippi to Florida and north along the coastal plain to the Carolinas. James noted, however, that differences between var. *exalbida* and var. *mariana* are quantitative and intergrading. Kral and Bostick (1969) observed that recognition of var. *exalbida* "might be held tenable on the basis of the floras of the Atlantic and eastern Gulf coastal plains" but that intergradation with the typical expression, especially in the Florida panhandle across to outer coastal plain to Texas, suggested to them that only a single entity should be recognized. The geography of chromosome counts reported by Kral and Bostick indicates that both var. *mariana* and var. *exalbida* are diploid. Emphasizing its geographic concentration in the southeastern corner of the species range, var. *exalbida* is treated for FNA as distinct at varietal rank. Only the broader-leaved, purple-petaled plants (var. *mariana*) occur in the northern and western parts of the range; narrow-leaved, often white-petaled plants with small hypanthia appear to be nearly exclusive in peninsular Florida; intergrades are common in the narrower region between the extremes.

As noted by Kral and Bostick (1969), *Rhexia mariana* is the most abundant and wide-ranging of the species. It is sympatric with all other species and apparently hybridizes with several, the hybrids often seemingly taking on characteristics of the other species. Hybrids and hybrid swarms of *R. mariana* with *R. salicifolia*, *R. virginica*, and *R. nashii* have been observed (James 1956; Kral & Bostick 1969).

The taxonomy here of species and varieties in *Rhexia* exactly matches that of LeBlond (2010), who provides a useful pair of keys (one using all characters, the other using only vegetative features) to the species.

### Infrageneric groups

Ideas about species groups in *Rhexia* have been discussed by earlier students of the genus (i.e., James 1956; Kral & Bostick 1969; Wurdack & Kral 1982; Ionta et al. 2007) and the groups formalized in the present account are for the most part similar to earlier ones.

Based primarily on anther morphology, James (1956) recognized two major groups among the species of *Rhexia*: "Series A," including *R. nuttallii*, *R. petiolata*, and *R. lutea*, and "Series B," including the rest of the species. Series B was noted to be "a very natural assemblage of species with the exception of *R. alifanus*" (emphasizing the anomalous seed morphology of the latter). He further divided Series A into two groups, observing that *R. lutea* differed in capsule morphology from the other two species, and Series B into subgroups, based first on stem morphology and then on root-rhizome morphology.

Kral and Bostick (1969) observed essentially the same pattern, for the most part closely following the discussion by James, adding that (p. 387) species of series A "show no tendency to cross-pollinate or at least do not produce successful hybrids, tend to have strikingly uniform morphologies over their range, and are less weedy. On the other hand most of the latter series [series B] (with the exception of *R. parviflora* and *R. alifanus*) do produce successful hybrids, show considerable diversity of morphology over their ranges, and are often weedy." They also noted (p. 388) that "On a basis of chromatographic and anatomical analysis of plant parts it would appear that

*R. lutea* in series 'A' and *R. alifanus* in series 'B' of James may actually represent distinct sections." The pattern observed by Wurdack and Kral (1982) was similar but they referred to four main groups ("four natural entities"), giving *R. alifanus* and *R. lutea* coordinate rank with series A and B.

Following Wurdack and Kral (1982), the present account recognizes four primary morphological groups (formal nomenclature validated below): (1) sect. *Rhexia* — series B of James excluding *R. alifanus*, (2) sect. *Cymborhexia* — *Rhexia alifanus* (3) sect. *Brevianthera* — series A of James excluding *R. lutea*, and (4) sect. *Luteorhexia* — *Rhexia lutea*. Each of the four sections appears to be monophyletic.

The species of sect. *Rhexia* are divided into two groups, corresponding to a difference in stem morphology. Data of Ionta et al. (2007, see comments below) suggest that the species of sect. *Rhexia* are likely to have reticulate relationships reflecting ancestral hybridization, thus the division into two groups may prove to be artificial. The apparent cauline specialization, however, is discontinuous and remarkably distinct.

### Stems and roots

Inequality in width and morphology of stem faces has commonly been used in keys to species of *Rhexia* — one set of opposing faces is broader and convex, the other narrower, concave, and paler. Another correlated difference apparently has not been previously described or it has been noted only obliquely in descriptions. In those species with "unequal" faces, the nature of the faces abruptly alternates 90 degrees at each node. In a given plane, at each successive node a narrow-concave face abruptly becomes a broad-convex face and vice versa. This feature is unequivocally interpreted. In the *Aequales* group of sect. *Rhexia*, sect. *Brevianthera*, and sect. *Luteorhexia*, the four stem faces are similar in morphology ("equal") and continuous across the nodes from one internode to the next. Stem faces of *R. nuttallii* and *R. petiolata* (sect. *Brevianthera*) and *R. lutea* (sect. *Luteorhexia*) were scored as "unequal" by Ionta et al. (2007), in disagreement with the observation here, insofar as that term refers to the 'alternating' morphology. "Equal" stem faces also are characteristic of species of *Arthrostemma* (pers. observ. and as recorded by Ionta et al. 2007).

In *Rhexia alifanus*, stems are not clearly demarcated as four faces — instead they are terete proximally, with internodes distally somewhat flattened in a plane parallel to the subtending leaf pair and longitudinally striate, the narrower bands paler and aligned with the leaf midribs. Stems of *R. alifanus* were recorded as having "unequal" faces by Ionta et al., but the morphology is not similar to either the "equal" or "unequal" division into faces as in other species of the genus.

Vegetative reproduction in sect. *Rhexia* is through adventitious buds from long, laterally extending, lignescent, rhizome-like roots (Fig. 2). These structures were correctly identified as roots by James (1956), following the earlier, detailed study by Holm (1907), but their identification as rhizomes (or "stolons" or "rootstocks") has persisted (e.g., Kral & Bostick 1969; Godfrey & Wooten 1981; Ionta et al. 2007) without mention of the earlier-observed distinction between rhizomes and roots. Root tubers (tuberous swellings; Fig. 1) are produced in most species of sect. *Rhexia*. Plants of sect. *Brevianthera* and sect. *Cymborhexia* produce only short lignescent-fibrous roots without tubers.

In sect. *Rhexia*, the tuberous swellings may develop on the primary root at the very base of the stem or at irregular positions on secondary roots. Adventitious buds arise from tuberous and non-tuberous portions of the root.



Figure 1a, b Vegetation reproduction in *Rhexia mariana* var. *mariana* through adventitious buds from rhizome-like roots. Root tubers are not produced in *R. mariana*. **Georgia**: Wayne Co. NW of Sterling, 16 Aug 1993, Kral 83069 (VDB)

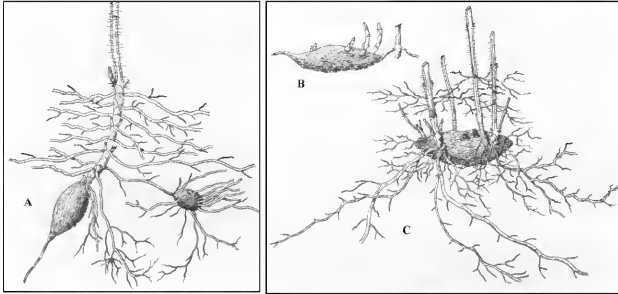


Figure 2a, b, c. Root tubers in *Rhexia virginica*, with adventitious buds and shoots originating from the tubers. From Holm (1907).

#### Phylogenetic study of Ionta et al.

Ionta et al. (2007) studied phylogenetic relationships among *Rhexia* species using DNA sequence data — ribosomal nuclear (ITS), chloroplast (trnC-D), and nuclear (ncpGS) — and a morphological data set of 37 characters, with outgroups (following Renner and Meyer 2001, Renner et al. 2001) as species of *Arthrostemma* and *Dissotis* Benth.

The ITS and trnC-D topologies "differed in the phylogenetic positions of several taxa (*Rhexia lutea*, *R. nashii*, and *R. salicifolia* [also of *R. cubensis*]), and for *R. cubensis*, *R. lutea*, *R. nashii*, *R. parviflora*, and *R. salicifolia*, we recovered multiple alleles of ncpGS, which is single copy in most species of *Rhexia*, indicating that these individuals may be of hybrid origin" (Ionta et al. 2007, p. 1055). Evidence suggests that *R. nashii* originated as a hybrid between the two groups of sect. *Rhexia* — one of its ncpGS alleles is sister to *R. mariana* while the other is sister to *R. virginica*.

Analyses of pruned data sets (eliminating taxa that appeared in different places in the ITS and trnC-D topologies and/or that had two copies of ncpGS) using all three molecular regions plus the morphology resulted in a single, strongly supported most parsimonious tree with three major clades: *Rhexia petiolata* (sect. *Brevianthera*), *R. mariana* (Inaequales group), and *R. virginica* (Aequales group).

*Rhexia lutea* shows as sister to the whole genus in the trnC-D analysis and as sister to the Inaequales group of sect. *Rhexia* in the ITS analysis. Morphology, in contrast, places it as sister to sect. *Brevianthera*. Advanced characters strongly linking these two groups (90% bootstrap value), as scored by Ionta et al., are glabrous petals (homoplasious), curved-ascending petals, strongly and shortly constricted hypanthia, and short anthers. As noted by Ionta et al. (p. 1065), this indicates that morphological synapomorphies of *R. lutea* with sect. *Brevianthera* "may be homoplasious ... or were passed to *R. lutea* as a result of ancient hybridization with a member (either extinct or extant) of the *R. petiolata* clade." Observation of multiple heterozygous ncpGS loci also supports this possibility.

*Rhexia alifanus* shows as sister to the Inaequales group of sect. *Rhexia* in the morphological analysis. Ionta et al. noted, however (p. 1061), that this position is not well supported. "Putative synapomorphies linking *R. alifanus* with this clade include leaf stomatal distribution ... and anthers

with elongated, narrowly conical-filiform dorsal connective appendages ... ." Equal distribution of stomates on both leaf surfaces occurs in *R. alifanus* and in *R. salicifolia* and *R. aristosa* (Aequales group) and *R. parviflora* and *R. cubensis* (Inaequales group), hardly supporting a link to one or the other group, if indeed the state is apomorphic. Conical anther appendages, which are present in *R. alifanus*, are present in *R. marilandica*, *R. nashii*, and *R. cubensis* (Inaequales group) but also in *R. virginica* (Aequales group).

Molecular data from all three genes, in contrast to the morphology, place *Rhexia alifanus* is sister to sect. *Brevianthera*. There appears to be no morphological character of *R. alifanus* that might be unequivocally interpreted as synapomorphic with sect. *Brevianthera*.

### Infrageneric classification

RHEXIA L., Sp. Pl. 1: 346. 1753. TYPE: *Rhexia virginica* L.

#### 1. Sect. RHEXIA TYPE: *Rhexia virginica* L.

Anthers elongate, (3–)4–8(–11) mm long, curved, opening by small pores, surfaces minutely papillate; caudex absent or weakly developed; roots long, laterally extending, budding adventitiously, with tuber-like swellings (in the interpretation here, this tendency lost in *R. parviflora* and in *R. mariana*, *R. interior*, and *R. ventricosa*); stems branched to unbranched or nearly so, axillary buds suppressed or not, stem faces subequal or unequal (see comments above, "Stems and roots"), hairy at least at nodes; leaves bifacial (dorsiventral), surfaces not glaucous; stomates mainly on abaxial lamina surface or more or less equally distributed on both surfaces; hypanthia with a short but distinctly tubular neck; petals plane and horizontal, petals white to pink to lavender or purple; capsule dehiscence only in the apical depression; seeds cochleate, 0.6–0.75 mm long, surfaces variously sculptured; chromosomes small (see comment under sect. *Cymborhexia*); diploids and polyploids.

##### 1a. The Eequales group

Species included: *R. aristosa* Britt. (2x), *R. salicifolia* Kral & Bostick (2x), *R. virginica* L. (2x, 4x), *R. interior* Pennell (4x), *R. ventricosa* Fern. & Griscom (4x)

Stem faces subequal; stomates on abaxial lamina surface (*R. virginica*, *R. interior*, *R. ventricosa*) or more or less equally distributed on both surfaces (*R. aristosa*, *R. salicifolia*).

##### 1b. The Inaequales group

Species included: *R. mariana* L. (2x), *R. cubensis* Griseb. (2x, 4x, 6x), *R. nashii* Small (4x, 6x), *R. parviflora* Chapm. (2x)

Stem faces unequal (see comments in text); stomates mainly on abaxial lamina surface (equally distributed on both surfaces in *R. cubensis*).

The anthers of *Rhexia parviflora* are relatively shorter (3–3.5 mm long) than those of other species of sect. *Rhexia*. James (1956) noted the difference in length but observed that the curvature, small pores, and papillate surfaces are similar to the anther morphology of his series B. The plane-horizontal petals also are similar to sect. *Rhexia* and the unequal stem faces suggest that its ancestry is connected with others of the Inaequales group, especially with *R. mariana*, which also produces white flowers.



Figure 3a, b, c, d. Representative species of the four sections. a. *Rhexia alifanus*. b. *Rhexia virginica*. c. *Rhexia petiolata*. d. *Rhexia lutea*. Photos a, b, and d by James Van Kley, from the Pineywoods Plants Digital Gallery; c by Fred Nation from the Alabama Plant Atlas website.



2. Sect. CYMBORHEXIA Nesom, sect. nov. TYPE: *Rhexia alifamum* Walt.Species included: *R. alifamum* Walt. (2x)

Anthers 7–8 mm long, curved, opening by small pores, surfaces smooth; caudex distinct, woody; roots short, fibrous, without adventitious buds or tubers; stems unbranched or nearly so, axillary buds suppressed, stem faces not demarcated, without ridges, terete proximally, internodes distally somewhat flattened in a plane parallel to that of the subtending leaf pair, longitudinally striate, the narrower bands paler and aligned with the leaf midribs), completely glabrous; leaves isofacial, surfaces glaucous, stomates more or less equally distributed on both surfaces; hypanthia with a very short but tubular neck; petals plane and horizontal, lavender-rose; capsule dehiscence only in the apical depression; seeds oblong-cuneate, subprismatic, 1–2 mm long, surfaces nearly smooth; chromosomes large (Kral and Bostick 1969 noted that the chromosomes of *R. alifamum* are relatively large compared to those in all other species); diploid.

3. Sect. BREVIANTHERA Nesom, sect. nov. TYPE: *Rhexia petiolata* Walt.Species included: *R. nuttallii* C.W. James (2x), *R. petiolata* Walt. (2x)

Anthers 1.2–2 mm long, straight, opening by large pores, surfaces smooth; caudex strongly (*R. lutea*) or weakly developed; roots short, fibrous, without adventitious buds or tubers; stems unbranched or nearly so, axillary buds suppressed, stem faces subequal, glabrous; leaves bifacial, surfaces not glaucous, stomates mainly on abaxial lamina surface; hypanthia with an indistinct neck region, abruptly constricted above the locules and then immediately flaring into the lobes; petals curved and ascending, lavender to purple or pink; capsule dehiscence by a partial separation of the capsular segments; seeds cochleate, 0.6–0.7 mm long, surfaces variously sculptured; chromosomes relatively small; diploids and polyploids.

4. Sect. LUTEORHEXIA Nesom, sect. nov. TYPE: *Rhexia lutea* Walt.Species included: *R. lutea* Walt. (4x)

Anthers ca. 2 mm long, straight, opening by large pores, surfaces smooth; caudex strongly (*R. lutea*) or weakly developed; roots short, fibrous, without adventitious buds or tubers; stems conspicuously branched, axillary buds not suppressed, stem faces subequal, hairy; leaves bifacial, surfaces not glaucous, stomates mainly on abaxial lamina surface; hypanthia with an indistinct neck region, abruptly constricted above the locules and then immediately flaring into the lobes; petals curved and ascending, yellow; capsule dehiscence only in the apical depression; seeds cochleate, 0.6–0.7 mm long, surfaces variously sculptured; chromosomes relatively small; polyploid.

KEY TO SECTIONS AND GROUPS OF *RHEXIA*

1. Anthers 1.2–2 mm long, straight, surfaces smooth, opening by large pores; petals curved and ascending.

2. Petals lavender to purple or pink; stems unbranched or nearly so, axillary buds suppressed, stem faces completely glabrous; inflorescences strongly condensed, obscured by foliaceous bracts; leaves short-petiolate ..... 3. sect. BREVIANTHERA

2. Petals yellow; stems conspicuously branched, axillary buds not suppressed, stem faces hairy; inflorescences diffuse, bracteate but not obscured by bracts; leaves subsessile

..... 4. sect. LUTEORHEXIA

1. Anthers (3–)4–8(–11) mm long, curved, surfaces smooth or minutely papillate, opening by small pores; petals plane and horizontal.

3. Caudex distinct, woody; roots short, ligneous-fibrous, without tubers; leaves isofacial, surfaces glaucous; anther surfaces smooth; seeds oblong-cuneate, subprismatic, 1–2 mm long, surfaces smooth; chromosomes large ..... 2. sect. **CYMBORHIXIA**
3. Caudex absent or weakly developed; roots often long and rhizome-like, commonly tuberiferous; leaves bifacial (dorsiventral), surfaces not glaucous; anther surfaces minutely papillate; seeds cochleate, 0.6–0.75 mm long, surfaces variously sculptured; chromosomes small ..... 1. sect. **RHIXIA**
4. Stem faces subequal ..... 1a. Aequales group
4. Stem faces unequal ..... 1b. Inaequales group

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## ANDROPOGON GLAUCOPSIS (POACEAE) IN TEXAS

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### ABSTRACT

*Andropogon glaucopsis*, purple bluestem or coastal bluestem, is documented by two collections as occurring in southeastern Texas at the westernmost extension of its range.

**KEY WORDS:** Poaceae, Andropogoneae, *Andropogon*, Pineywoods, Texas

*Andropogon glaucopsis* Elliott (Poaceae, tribe: Andropogoneae), purple bluestem or coastal bluestem, has long been treated as a variety (or referred to synonymy) of *A. virginicus* L. or *A. glomeratus* (Walt.) Britton, Stearns, & Poggenb. (Fernald 1950; Radford et al 1968; Campbell 2003; and others). In 2011, Weakley et al. resurrected the species based upon its distinct morphology, distribution, and apparent lack of intergradation with *A. glomeratus*. The species is mentioned in the Illustrated Flora of East Texas, Vol. 1 (Diggs et al. 2006), where it is treated as *A. virginicus*, presumably in synonymy. This mention is based upon the Shinners specimen (Fig. 1) cited below, which was originally identified as *A. virginicus*. In 2001, Sorrie annotated the specimen as *A. glaucopsis* with the notation that it is a state record. Unfortunately, this information was never published. Weakley (2011) has cited the distribution of *A. glaucopsis* as "Se. VA south to c. peninsular FL and west to e. TX. The extent of the western Gulf Coastal Plain distribution (to the West Gulf Coastal Plain of w. LA and e. TX) is based on specimens (at BRIT) and sight records (B. Sorrie, pers. comm.)." USDA, NRSC (2012) does not include Texas as part of the distribution of the species.

Recent field studies in the longleaf pine area of the Pineywoods vegetational region of Texas have resulted in the discovery and collection of an additional specimen of *Andropogon glaucopsis*, hence our interest in the species. The purpose of this paper is not to report the presence of the species within the state, for that has been previously noted, but to document, under the name we are following, its occurrence in two counties of Texas by citation of specimens and additional remarks.

Voucher specimens: **Texas. Hardin Co.:** 0.3 mi W of jct of Paula Road and U.S. Hwy 69 on W side of Paula Road, wetland savanna with pimple mounds, 19 Oct 2009, *Singhurst 17778* (BAYLU). **Jasper Co.:** 3 miles SSE of Buna, border of pine-hardwood stand, sandy loam, 6 Nov 1966, *Shinners 31669* (SMU). Figure 1.

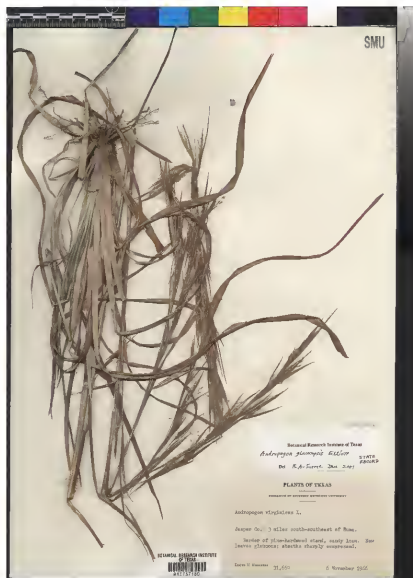


Figure 1. *Andropogon glaucopsis* (Shimmers 31669, SMU) Used with permission of BRIT Virtual Herbarium. Atrium Biodiversity Information System for the Botanical Research Institute of Texas. <<http://atrium.brit.org>>. Accessed February 2012.

The longleaf pine area of Texas is the western edge of a forest of similar character that extends eastward to Virginia (Bray 1906; Frost 1993; Diggs et al. 2006). Both the Texas and the western and northern Louisiana longleaf pine areas are, due to the Mississippi River embayment, discontinuous (disjunct) from the longleaf pine regions east of the Mississippi River. The *Andropogon* collected by Singhurst occurred in a "wet pine savanna," which is characterized by poorly drained sandy-loam soils and periodic occurrences of fires (Diggs et al 2006). The number of woody species is limited by fluctuating water levels, while those that tolerate the wet conditions are limited by fire. Characteristic species included *Rhynchospora divergens*, *R. elliptica*, *R. flitfolia*, *R. plumosa*, *Scleria georgiana*, *S. reticularis*, *Schizachyrium scoparium*, *Eriocaulon decangulare*, *Aletris aurea*, *Drosera capillaris*, *Pinguicula pumila*, *Arnoglossum ovatum*, *Fuirena brevifolia*, *Hypericum galloides*, *Hyptis alata*, *Liatris acidota*, *Liatris pycnostachya*, *Ludwigia linearis*, *Lycopodiella appressa*, *Marshallia tenuifolia*, *Mitreola sessilifolia*, *Myrica cerifera*, *Panicum tenerum*, *Pinus palustris*, *Polygala ramosa*, *Rhexia lutea*, *Xyris ambigua*, and *X. louisianica*. Wet pine savannas are overgrown by *Nyssa sylvatica*, *Liquidambar styraciflua*, *Acer rubrum*, and *Magnolia virginiana* when fire is excluded. Nothing other than what is on the label is known about the Shinners specimen.

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**NOMENCLATURAL AND TAXONOMIC ANALYSIS  
OF *CONVALLARIA MAJALIS*, *C. MAJUSCULA*, AND *C. MONTANA*  
(RUSCACEAE/LILIACEAE)**

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**ABSTRACT**

*Convallaria montana* Raf. is shown to be a superfluous name for *C. pseudomajalis* Bartr., which was likely based on a specimen of *Polygonatum*, so that the earliest available name for the American lily-of-the-valley is *C. majuscula* Greene. Two new combinations proposed: *C. majalis* L. subsp. *majuscula* (Greene) Gandhi, Reveal, and Zarucchi and *C. majalis* var. *majuscula* (Greene) Gandhi, Reveal, and Zarucchi. A neotype is chosen for *Convallaria majuscula* Greene.

**KEY WORDS:** Nomenclature, eastern North America, *Convallaria majalis* subsp. *majuscula*, *Convallaria pseudomajalis*, lily-of-the-valley

The American lily-of-the-valley has been known under the following names: *Convallaria majalis* L. (Michaux 1803: 201; Pursh 1813: 232; Nuttall 1818: 224; Elliott 1817: 396; Britton & Brown 1896: 434; Small 1933: 301; Gleason & Cronquist 1991: 839), *C. montana* Raf. (Fernald 1944: 14), *C. majuscula* Greene (USDA, NRCS 2012), "*C. majalis* var. *montana* (Raf.) H.E. Ahles" (Utech 2002: 206), and *C. majalis* var. *montana* H.E. Ahles (USDA, ARS, National Genetic Resources Program, 2012). The known range of this taxon is confined mainly to the Appalachian Mountains of the eastern United States in northern Georgia, southeastern Kentucky, western North Carolina, northwestern South Carolina, eastern Tennessee, western Virginia, and West Virginia.

Typical *Convallaria majalis* is a native of Europe. Among those who applied this name to the American plants, it was Small (1933) who distinguished the American plants from their European counterparts as follows: "The native American plant usually has a shorter inflorescence, and has larger bracts and an oblate seed." In contrast, Gleason and Cronquist (1991) were of the opinion that the "seemingly native" plants are "casually escaped plants" and "may reflect an early escape of a different phase of sp. [*C. majalis*] in cultivation." Others, such as Michaux (1803) and Pursh (1813), did not comment on the nativity of the American plants.

During a comparative study of the specimens of *Convallaria majalis* and *C. majuscula*, we discovered a nomenclatural problem that was previously overlooked.

William Bartram (1810), who was the first to distinguish the American native taxon from the European taxon, assigned to it the name *Convallaria pseudomajalis* and remarked: "It differs but little from *C. majalis* of Europe, only is larger every way, and the fruit blue more oblong to ovate." Although Rafinesque (1840: 66) was aware of Bartram's name, he proposed the name *Convallaria montana* for the American plants and at the same time cited *C. pseudomajalis* as a synonym. Thus, *C. montana* was superfluous and illegitimate when published, and it is automatically typified on the type of *C. pseudomajalis*. Within his treatment, Rafinesque mentioned that according to Bartram, "the berries are blue and ovate." Rafinesque characterized his *C. montana*, after a Latin description, where he mentioned "fol. binis sessilib. ovatoobl. acum." and "racemo 10-12floris, bract. lanc. ad ped. eq. fl. secundis" as a "large plant, leaves 6 to 8 inches long, 2 wide, fl. size of *C. majalis*." He contrasted *C. majalis* with "leaves petiolate elliptic acute" (size not given) and "raceme of 7-8 fl. bracts half the length of the pedicels."

Greene (1908: 46), without a reference to Bartram or Rafinesque, proposed *Convallaria majuscula*. He characterized his species as with "very large light-green leaves without trace of bloom, with excessively fibrous anatomy, inasmuch that the surface of the leaf when growing looks to be plicate rather than plane and even."

Fernald (1944: 12-14) emphasized the nativity of the American plants. He treated *Convallaria montana* and *C. majuscula* as conspecific. Based on the priority, he accepted *C. montana* and cited *C. majuscula* as its synonym. Based on Bartram's description of the fruits as blue, Fernald speculated that that "Bartram could quite as well have had *Polygonatum*!" For this reason, he excluded *C. pseudomajalis* (the illegitimacy-causing synonym) from *C. montana*, and thus he inadvertently created "*C. montana* Fernald" as a later homonym (Vienna Code Art. 48.1 applies; McNeill et al. 2006). Ahles (1964: 172), seemingly unaware of the illegitimacy of *C. montana* Raf., transferred it to *C. majalis* at the rank of a variety and thus effectively created a *nomen novum* for the Rafinesque name. Since he did not exclude Bartram's *C. pseudomajalis* from his var. *montana*, the varietal name is automatically typified by the type of Bartram's species.

In our study, we looked for the earliest collection records of the Appalachian native plants. Because it was included in Pursh's treatment ("On the highest mountains of Virginia and Carolina"), it is evident that it was collected before 1813. We located the following pre-1900 collections: (1) 1838: S.B. Buckley (MO, NY, US); (2) 1839: J. Reinhart (GH) and J. Torrey (GH); (3) 1841: A. Gray & J. Carey (GH); (4) 1871: A.H. Curtiss (NY); (5) 1873: A.H. Curtiss (GH, MO, NDG, NY); (6) 1874: A.H. Curtiss (US); (7) 1878: H. Shriver (NY); (8) 1890: W.M. Canby (GH, MO, NY) and A. Brown et al. (NY); and (9) 1892: N.L. Britton et al. (NY) and J.K. Small (MO). None of the specimens was annotated by Greene.

We also found that most of the traditional, distinguishing characters between the American and European plants overlap, such as leaf size and number of flowers per raceme. Nevertheless, the bract/pedicel length ratio and flowering raceme/leaf blade length ratio appear to be informative. Furthermore, cultivated populations of *Convallaria majalis* and the native populations of *C. majuscula* are allopatric. Accordingly, we follow Ahles (1964) and Utech (2002) in treating the American plants at the infraspecific rank.

1. Plants forming dense colonies; leaves green until frost, veins faint; raceme (excluding scape) about half the length of the leaves; bracts 4-10 mm long, shorter than the pedicels; seeds almost globose ..... subsp. *majalis*
1. Plants scattered or forming small groups; leaves yellowing in late summer, veins strong; raceme (excluding scape) much shorter than the leaves; bracts 8-20 mm long, usually as long or longer than pedicels; seeds oblate or lenticular ..... subsp. *majuscula*

## Typification

Since no known type exists for *Convallaria majuscula*, the name needs to be neotypified. We found that the GH, NDG, and NY specimens of the A.H. Curtiss collection made in 1873 bear a 1966 annotation by H.H. Iltis as “neotype.” Two specimens (MO) of this collection do not have Iltis’s annotation, and to the best of our knowledge, Iltis did not publish his designation. We communicated with Iltis asking for any information on his neotype designation but did not receive any response. Therefore, we opt to neotypify *C. majuscula* here.

*Convallaria majalis* L. subsp. *majuscula* (Greene) Gandhi, Reveal, and Zarucchi [comb. et stat. nov.] var. *majuscula* (Greene) Gandhi, Reveal, and Zarucchi [comb. et stat. nov.]. Basionym: *Convallaria majuscula* Greene, Repert. Spec. Nov. Regni Veg. 5: 46. 1908. NEOTYPE (designated here): USA. Virginia. Bedford Co.: Peaks of Otter, alt. 3500 ft, 2 Jun 1873, A.H. Curtiss s.n. (GH; isoneotypes: MO-2 sheets, NDG, NY).

Synonyms: *C. montana* Fernald, Rhodora 46: 14. 1944, nom. illeg., non Raf. 1840; *C. montana* sensu Raf., Aut. Bot. 1(Cent. V): 66. 1840, p.p., excluding the reference to *C. pseudomajalis*; *C. majalis* var. *montana* sensu H.E. Ahles, J. Elisha Mitchell Sci. Soc. 80: 172. 1964, p.p., excluding the type.

## ACKNOWLEDGMENTS

We thank Dr. Werner Greuter (B) and Dr. John H. Wiersema (BARC) for a nomenclature discussion and Dr. Alan S. Weakley (NCU) and Dr. David E. Boufford (GH) for comments on the taxonomy of *Convallaria majuscula*. We also thank Dr. John Boggan and Ms. Ingrid Lin (US) for the digitized images of Buckley’s and A.H. Curtiss’s collections, Dr. Thomas A. Zanoni and Ms. Lucy Klebieko (NY) for making NY’s pre-1900 collections of *C. majuscula* available on the web, and Ms. Emily W. Wood (A, GH) and Dr. Barbara J. Hellenthal (ND, NDG) for making the *Convallaria* specimens of NDG available to us for this study.

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## THE SHELL OF CATESBY'S HERMIT-CRAB

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### ABSTRACT

When the English naturalist Mark Catesby illustrated “*The Hermit-Crab*” in 1734, he pictured it inside the shell of the West Indian topsnail, *Cittarium pica* (Linnaeus, 1758). This creature was not accounted for in a 2012 review of the plant and animals illustrated by Catesby.

In an earlier volume of *Phytoneuron* (Reveal 2012), a nomenclatural summary of the plants and animals illustrated by the English naturalist and artist Mark Catesby (1683–1749) was presented. It did not occur to me in treating the creatures on t. 33 of the second volume published in 1834 that the shell in which Catesby positioned the land hermit crab, *Ceponobita clypeatus* (Fabricius, 1787), was identifiable. Dr. Robert Robertson, the emeritus curator of the Department of Malacology at the Academy of Natural Sciences in Philadelphia, soon sent me his paper (Robertson 2003) on the edible West Indian “whelk” in which he discusses the natural history of *Cittarium pica* (Linnaeus 1758) and even reproduced the Catesby image (his fig. 5, p. 34). The reason I failed to identify the shell was that Catesby himself did not propose a name. Yet, Catesby had a discussion and mentioned a generic name:

The shells they [the hermit crab] mostly make use of are of the *Buccinum* kind, whose spiral form is most fit to hold them fast, and secure them in the shell, in which they can fix themselves to fast, by means of short claws at their tails, that in pulling them out of it, the tender part separates from the crustaceous, and remain in the spiral part of the shell

Catesby's use of the expression “of the *Buccinum* kind” is understandable as the common whelk, *Buccinum undatum* Linnaeus (Syst. Nat., ed. 10, 1: 740. 1758), is a large snail common to many an English garden and is frequently encountered in coastal marine waters where, not surprisingly, they are the home of large hermit crabs. Linnaeus recognized that the Old World snail differed from the one in the New World and named the West Indian topsnail *Turbo pica* (Linnaeus, Syst. Nat., ed. 10, 1: 763. 1758) making, like me, no reference to the Catesby illustration.

Recognition of Catesby's shell was not new with Dr. Robertson's paper. Broderip (1828) identified the shell stating (p. 206) that “Catesby gives a figure of *Pagurus Diogenes* in the shell of *Turbo Pica*.” Nonetheless, failure to note this lies with me.

Two other oversights in my 2012 paper require comment. Thanks to the editor's mother-in-law, Carol Wells of Natchitoches, Louisiana, I can only repeat her comment that likely Catesby's father did not survive him as I implied, nor did Catesby go to the Bermuda Islands as a ghost. Thus, Catesby's father passed in 1705 (not 1805, p. 1), and his visit to the Islands was in 1725 (not 1825, p. 2). Neither the editor nor I have any excuses except to note that many others read an early version of this manuscript and also failed to spot the obvious!

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# TAXONOMY AND DISTRIBUTION OF THE *ZINNIA ACEROSA* (ASTERACEAE) COMPLEX

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## ABSTRACT

A taxonomic treatment of the *Zinnia acerosa* (DC.) A. Gray complex is provided. Six species are recognized: *Zinnia acerosa*, *Zinnia austrotexana* B.L. Turner, sp. nov., *Zinnia citrea* Torres, *Zinnia guanajuatensis* comb. et stat. nov., *Zinnia coahuilana* B.L. Turner, sp. nov., and *Zinnia oligantha* I.M. Johnston. Photos of the type specimens of the new taxa are provided along with a map showing their distributions.

**KEY WORDS:** Asteraceae, *Zinnia*, *Z. acerosa*, Texas, Mexico, Coahuila

*Zinnia acerosa* is typified by material collected in the Mexican state of San Luis Potosí by Berlandier (Torres 1963). Torres, following Robinson and Greenman (1896), placed *Z. pumila* A. Gray, typified by a Gregg collection from south-central Coahuila, as the only synonym of the species. I also accept such a disposition.

Torres did not recognize infraspecific taxa within his concept of *Zinnia acerosa*, but he did propose new specific taxa from among its cohorts, namely *Z. citrea*, a tetraploid taxon having bright yellow rays but otherwise very similar to *Z. acerosa*. Its validity also is accepted here and I also propose below three new species from the *Z. acerosa* complex — *Z. coahuilana*, a striking taxon with elongate, ciliate-margined but otherwise glabrous leaves and markedly pedunculate, large heads bearing 8 ray florets; *Z. guanajuatensis*, a localized taxon from the state of Guanajuato, Mexico, possessing a prostrate habit, originally proposed as a variety of *Z. acerosa* by Rzedowski and Rzedowski (1996); and *Z. austrotexana*, a highly localized taxon of southern Texas having more numerous disc and ray florets that dry pale yellow. The following key should serve to identify members of the *Zinnia acerosa* complex, as currently perceived.

## Key to the *Zinnia acerosa* complex

1. Rays bright lemon-yellow ..... *Zinnia citrea*
1. Rays white or pale lemon-yellow.
  2. Ray florets 2–3; disc florets 2–4(–5) ..... *Zinnia oligantha*
  2. Ray florets 5–8; disc florets 5–20.
    3. Leaves elongate, ca 3 cm long, glabrous; north-central Coahuila ..... *Zinnia coahuilana*
    3. Leaves variously curvate, 1–2 cm long, clearly pubescent; widespread.
      4. Stems mostly prostrate; Guanajuato, Mexico ..... *Zinnia guanajuatensis*
      4. Stems mostly erect; USA and north-central Mexico.
        5. Ray florets 5–8, the ligules drying pale yellow; disc florets 10–20  
..... *Zinnia austrotexana*
        5. Ray florets mostly 5, the ligules drying chalky white; disc florets 5–10  
..... *Zinnia acerosa*

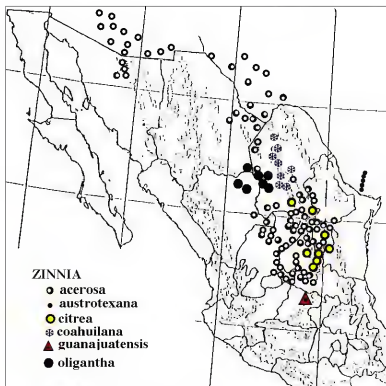


Figure 1. Distribution of the *Zinnia acerosa* complex

**ZINNIA ACEROSA** (DC.) A. Gray, Pl Wright, 1: 103. 1850. *Diplothrux acerosa* DC., Prodr. 5: 611. 1836. TYPE: MEXICO. San Luis Potosi. Dec 1827, J.L. Berlandier 1343 (holotype: G-DC, isotypes: MO digital image<sup>1</sup>, NY).

*Zinnia pumila* A. Gray, Mem Amer. Acad. Arts, n. ser., 4: 81. 1849. LECTOTYPE (designated here): MEXICO. Coahuila. Near San Juan de la Vaqueria, high plain, 20 May 1847, J. Gregg 722 (GH). Annotated by A. Gray as "n. sp."

Torres cited the type as "T: High plains near San Juan de la Vaqueria, and at Castanola in northern Mexico, Gregg 279, GH," essentially repeating the protologue for the geographic information ("High plain near San Juan de la Vaqueria, and at Castanola, in North Mexico, Dr. Gregg"). The choice of "type" by Torres, however, is problematic. In 1959 he annotated as *Zinnia pumila* this sheet Coahuila. Near Buena Vista Battlefield, dry plains, 24 Jul 1848, J. Gregg 279 (GH). Another GH sheet has two specimens of *Zinnia* mounted at the bottom: (1) Gregg 279 with the same collection data as the one above and (2)

*Gregg 722*, as in the type citation above; this sheet has two non-type collections mounted on the upper portion (fide HUH 2012). *Gregg 722* (not 279) is the appropriate choice of lectotype.

As noted by Torres (1963, p. 9), "The species includes four known chromosome races ( $n = 10, 11, 19$ , and  $20$ ), which cannot be distinguished morphologically at the present time. ... Genetically, the widespread  $n = 10$  race is most closely allied to *Z. juniperifolia* (Torres 1961), although morphologically it is closely similar to *Z. oligantha*. The  $n = 20$  race is of allopolyploid origin to judge from crossing results; possibly it is an allotetraploid derived from *Z. acerosa* ( $n = 10$ ) and *Z. oligantha*." Torres's diploid counts for *Z. acerosa* were from San Luis Potosí, Arizona, and New Mexico; tetraploid counts were from Texas (Brewster Co.) and Coahuila (near Saltillo).

**ZINNIA AUSTROTEXANA** B.L. Turner, sp. nov. Figure 1. **TYPE:** USA. **TEXAS.** Starr Co.: rare in opening in medium-stature thorn shrubland on gravelly saline clay soils (Catarina Series), on gentle slope underlain by Catahoula and Frio formations undivided, NE of near cabin along S fenceline on Las Estrellas Preserve, ca 7.5 mi NW to NNW of jct US 83 and F. M. 755 in downtown Rio Grande City, 270 ft, 5 Aug 2010, *W.R. Carr 29100* with A. Treuer-Kuehn (holotype: TEX).

Resembling *Zinnia acerosa* (DC.) Gray but ray florets mostly more numerous ((5–)8 vs 4–6), ligules, upon drying, pale lemon-yellow (vs white), and usually more numerous disc florets (10–20 vs 10 or fewer). The epithet refers to southern Texas, to which the taxon is confined.

**Suffruticose taprooted herbs**, 10–15 cm high. Leaves loosely arcuate, 10–20 mm long, pubescent with short hairs. Heads campanulate, 6–10 mm high, 4–8 mm across (rays excluded); bracts imbricate, 4–6 seriate, their apices broadly rounded and ciliate. **Peduncles** sparsely pubescent, 5–12 mm long. **Ray florets** (5–)8, pistillate, fertile; ligules drying pale lemon-yellow, 5–8 mm long, 4–6 mm wide; achenes ca 3 mm long, epappose or minutely 2-awned. **Disc florets** 10–20; corollas glabrous, yellow; achenes ca 3 mm long, pubescent with short erect hairs; pappus of 2 short awns, or absent. **Chromosome number**,  $n = 10$  pairs, plus a single univalent (Turner 4499, TEX).

**Additional collections examined.** USA. **TEXAS.** Jim Hogg Co.: 12 mi S of Petroleum, 28 Jun 1962, *Correll & Johnston 25634* (LL); ca 1 mi S of Thompsonville, on rocky slopes of breaks, 13 Jun 1963, *Correll & Wasshausen 27718* (LL); San Antonio Viejo Ranch, local on shallow, gravelly soil over the Catahoula formation, 30 Oct 2010, *Treuer-Kuehn IV-0941* (TEX); 17.6 mi SW of Hebberville along Farm Rd. 3073, 5 Jun 1983, *Turner 15116* (TEX). Starr Co.: 8 mi N of Rio Grande City, 31 Aug 1932, *Clover 479* (LL); 10 mi N of Rio Grande City, 29–30 Sep 1951, *Runyon 4405* (TEX); local on shallow, gravelly soil over the Goliad formation, 26° 45' 29.582" N, 98° 46' 58.569" W, 14 Oct 2010, *Treuer-Kuehn IV-0951.2* (TEX); 9 mi W of Rio Grande City, 8 Mar 1959, *Turner 4499* (TEX); dry hills, Fronton Road, 9 Oct 1965, *Wood 511* (TEX).

*Zinnia austrotexana* is relatively rare and is known to occur only along the roadsides of westernmost Jim Hogg and Starr counties (Fig. 3), mostly between Miranda City and Roma, where geological outcroppings of Frio Clay and Catahoula tuff occur, this well documented by the comments of Carr on the label of the type collection. Torres (1963) apparently did not examine material of the novelty, to judge from his description of *Z. acerosa*, which noted that it had "4–6" ray florets and "8–13" disc florets. Plants of *Z. austrotexana* typically have 8 ray florets and 10–20 disc florets, but occasional plants have 5–6 ray florets.

My initial inclinations were to treat this relatively isolated, south Texas population system as a variety of *Zinnia acerosa* in recognition of its relatively weak morphological differentiation, but its seemingly consistent number of ray and disc florets, rarity, and confinement to specific geological outcrops has led to its treatment at the specific level.

In the fall of 2011, in company with Jana Kos, I revisited the two sites from which specimens of *Zinnia austrotexana* were gathered much earlier, but we were unable to relocate the taxon, perhaps due to the unusual drought conditions of that year but surely also to the considerable disturbances at the sites concerned. The Starr County location is now an assemblage of roadside houses



Figure 2. *Zinnia austrotexana*, holotype TEX



Figure 3a, b. *Zinnia austrotexana* at the type locality in Starr County, Texas. Photos by Bill Carr.



**ZINNIA CITREA** Torres, Madrono 15: 215. 1960. TYPE: MEXICO. San Luis Potosí. Mpio. de Guadalcázar: near San Domingo, 1979 [the type grown in the greenhouse from seed collected at the type locality], *A.M. Torres 139* (holotype: IND).

According to Torres (1963), *Zinnia citrea* is a tetraploid, possessing characters of both *Z. juniperifolia* and *Z. acerosa*. Because of this he suggested that it might be "an allopatric derivative of the two."

*Zinnia citrea* is known to occur within populations of the white-rayed *Z. acerosa*, no intermediates observed (as noted on the collection label of *Nesom 6694*, TEX). The distribution of *Z. citrea*, as currently known, is shown in Figure 2.

**ZINNIA COAHUILANA** B.L. Turner, sp. nov. Figure 2. TYPE: MEXICO. Coahuila. ca 39 mi SSW of Cuatro Ciénegas, on the upper limestone slopes of Sierra de Los Alamitos, 11.6 road miles S of Hwy 30, on the road to Los Cuates de Australia, starting just W of El Hundido, near KM 139, S-facing slope, 23 Sep 2004, *J. Henrickson 24116* (holotype: TEX).

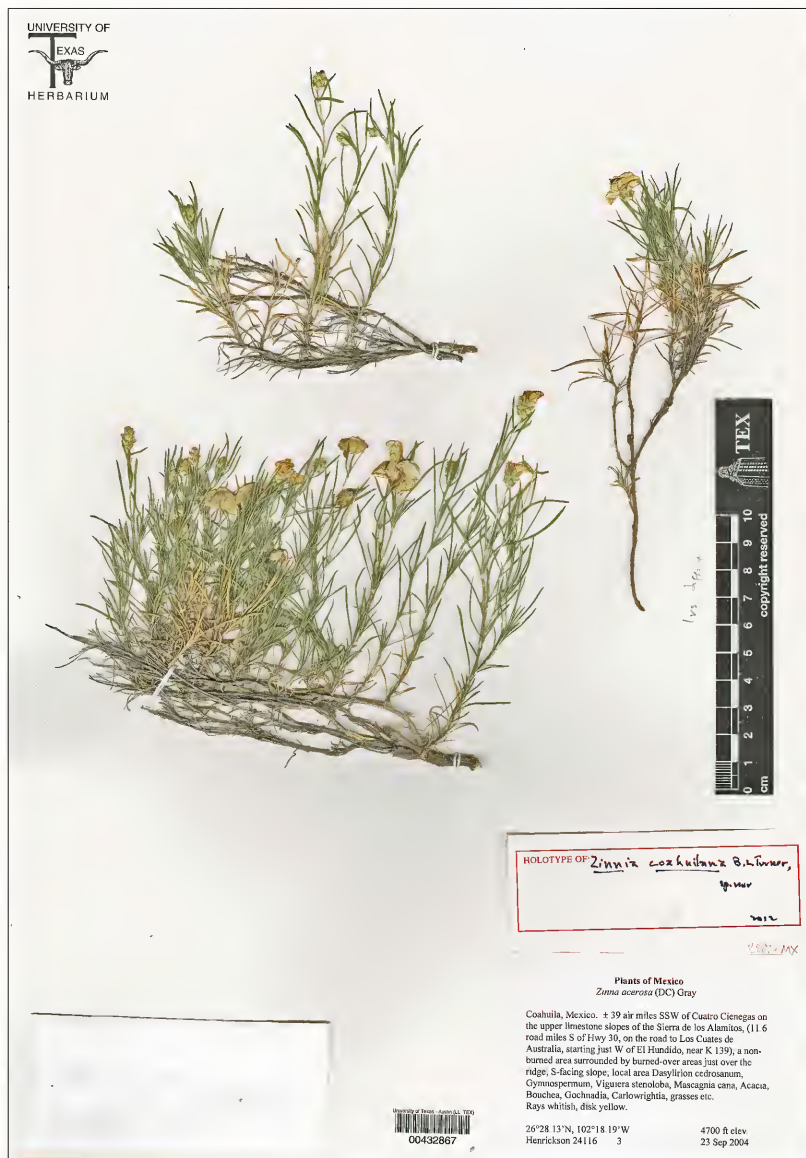
Resembling *Zinnia acerosa* (DC.) A. Gray but the leaves ca 3 cm long and straight (vs 1–2 cm and variously recurved), glabrous with sparsely short-ciliate margins (vs variously pubescent with mostly ciliate margins); heads with mostly 8 ray florets (vs 4–6) borne on nearly glabrous peduncles 2–4 cm long (vs mostly 2 cm long or less).

Perennial herbs, 10–20 cm high. Midstem and upper leaves mostly linear, ca 3 cm long, glabrous or nearly so, the margins minutely, but sparsely ciliate. Heads 10–11 mm high, 5–6 mm wide (rays excluded). Peduncles 2–4 cm long, sparsely pubescent to glabrate. Involucres glabrous or nearly so; bracts imbricate, 5–6 seriate, their apices broadly rounded with scarious margins. Receptacles conical, ca 1 mm high, 1.5 mm across; pales scarious, linear-lanceolate, ca 8 mm long. Ray florets 8, pistillate, fertile; ligules white, 9–12 mm long, 5–7 mm wide; achenes ca 5 mm long, 1.5 mm wide, epappose. Disc florets ca 20 per head; corollas yellow, 4–5 mm long, glabrous; achenes 3–4 mm long, black, glabrous or nearly so; pappus of 2 unequal awns, 1–4 mm long.

Representative collections examined. MEXICO. Coahuila. Mpio. M. Muzquiz: ca 130 road km NW of Muzquiz on Coa Hwy 2A, mid slope of Sa. La Encantada basin and mining areas, scattered but common on relatively flat areas near bottom of slope, forming large masses, 28° 30' 40" N, 102° 19' 30" W, 3 Jun 1992, *Nesom 7389* (TEX); Mpio. Ocampo: La Cuesta del Plomo on the Muzquiz-Boquillas highway, 1750–1775 m, 28° 44' N, 102° 31' W, steep limestone slopes and canyons, 14 Sep 1972, *Chiang et al. 9213a* (TEX); Mpio. San Pedro Colonias: northern flank of Sierra de los Alamitos, 26° 20' N, 102° 20' W, 1450 m, 13 Jun 1972, *Chiang et al. 7716* (TEX); Mpio. Villa Acuna: Rancho El Rincon, SW margin of Serranías del Burro, ca 80 km SE of Big Bend National Park, Texas, 1400–2100 m, 23 Jun 1991, *Ruiz 43*; same locality, 15 Jul 1991, *Ruiz 110* (TEX).

*Zinnia coahuilana* is clearly closely related to *Z. acerosa* but readily distinguished by its more elongate, glabrous leaves, larger, mostly glabrous heads on more elongate peduncles, and more numerous mostly larger rays. Clear intergrades between *Z. coahuilana* and *Z. acerosa* in regions of near contact have not been observed. None of the specimens cited above was examined by Torres (1963) in his seminal study of the *Z. acerosa* complex.

The epithet refers to the state of Coahuila, Mexico, to which the novelty is seemingly confined (Fig. 3).

Figure 4. *Zinnia coahuilana*, holotype TEX.

**ZINNIA GUANAJUATENSIS** (Calderón & Rzedowski) B.L. Turner, **comb. et stat. nov.** *Zinnia acerosa* var. *guanajuatensis* Calderon & Rzedowski, Acta Bot. Mex. 36: 78. 1996. **TYPE:** MEXICO. Guanajuato. Mpio. de San Luis de la Paz: cerca de Pregón, ladera caliza con vegetación de pastizal, 2100 m, 22 Aug 1988, J. Rzedowski 47043 (isotype: TEX!).

*Zinnia guanajuatensis* is a well-circumscribed taxon readily distinguished from *Z. acerosa* by its low, prostrate habit, heads with more numerous florets, and distinctive achenes, as noted by its authors. Further, the taxon is known by seven or more, relatively uniform populations, all from the Mpio. de San Luis de la Paz, and no intergradation between the two taxa is noted, suggesting that their recognition at specific rank is appropriate.

**ZINNIA OLIGANTHA** I.M. Johnst., J. Arnold Arb. 21: 74. 1940. **TYPE:** MEXICO. Coahuila. [Mpio. Sierra Mojada:] road from Mohovano northeast to Estancia Station, 13 mi S of Laguna del Rey, on old dunes, 21 Sep 1938, I.M. Johnston 7821 (holotype: GH).

Torres (1963) provided an excellent account of *Zinnia oligantha*, noting its few-flowered heads and diploid chromosome count of  $n = 10$ . He further noted that "Morphologically, it is most like *Z. acerosa*. It is suspected of containing a genome that is non-homologous to those in diploid *Z. acerosa* and *Z. juniperifolia*."

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## *CERASTIUM SEMIDECANDRUM* (CARYOPHYLLACEAE) IN TEXAS

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### ABSTRACT

*Cerastium semidecandrum* (Caryophyllaceae) is reported as new to the flora of Texas. This species was collected in both a city park and a vacant lot in Sulphur Springs, Hopkins County, in the northeastern corner of the state.

**KEY WORDS:** Caryophyllaceae, *Cerastium*, Texas, Hopkins County, adventive

*Cerastium semidecandrum* L. (Caryophyllaceae; fivestamen chickweed) was recently discovered in the town of Sulphur Springs in Hopkins County of northeast Texas — it has been collected there in Buford Park and in a nearby vacant lot. There are no previous reports of this introduced species in the state.

At the Buford Park site it was growing in full sun in thin to bare patches in the Bermuda grass turf both as scattered lone individuals and in dense patches, where it was locally abundant, often intermixed with the associated species including *Erodium cicutarium*, *Capsella bursa-pastoris*, *Stellaria* sp., *Soliva pterosperma*, *Veronica persica*, *Lepidium densiflora*, *Lamium amplexicaule*, *Houstonia rosea*, *Sherardia arvensis*, *Krigia* sp., and *Medicago* sp. At the vacant lot, associated species included many of the same species as well as *Erigeron philadelphicus*, *Claytonia virginica*, and *Houstonia pusilla*. *Cerastium semidecandrum* appears to be well established at both of the sites in Sulphur Springs.

Voucher specimens. USA. Texas. Hopkins Co.: just S of Connally Street in Buford Park, 33° 08' 17.06" N, 95° 36' 52.06" W, 7 Feb 2012, *M. White s.n.* (BAYLU); vacant lot, 250 ft W of intersection of League and Main, Sulphur Springs, 33° 08'02.71 N, 95° 36' 48.81" W, 16 Feb 2012, *M. White s.n.* (BAYLU).

*Cerastium semidecandrum* is a small, annual species that closely resembles *C. pumilum* but is easily distinguished by the broad, conspicuous, white to translucent bract and sepal margins (Morton 2005; Yatskievych 2006). The plant shown in Figure 1 was just beginning to flower.

This species is native to Eurasia and adventive in North America. According to de Schweinitz (1832) this species arrived on this continent as seed contaminant, although no dates were cited. While Mack and Erneberg (2002) suggested that this assertion reflected “informed opinion” instead of careful documentation, it is clear that the species was early introduced on this continent and is not a recent arrival though it is not possible to say how long it has been established in Texas. It is known from scattered collections throughout many of the states and provinces east of the Great Plains as well as several in the Pacific Northwest (Morton 2005). Due to its inconspicuous and ephemeral nature, it may well be more frequent than is generally known — especially in Texas and in Louisiana and Arkansas, where it has been only sporadically collected (BONAP 2012).

## ACKNOWLEDGMENTS

We would like to thank Joe Jackson, reference librarian at Paris Junior College for help obtaining literature.

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Figure 1. *Cerastium semidecandrum*. Note the very broad, scarios margins of the sepals. Photograph taken at Buford Park in Sulphur Springs, Hopkins Co., Texas, 7 February 2012.

## TWO INTERSECTIONAL HYBRIDS IN *LIATRIS* (ASTERACEAE) FROM EAST TEXAS

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### ABSTRACT

A hybrid between *Liatris squarrosa* var. *glabrata* (sect. *Liatris*) and *L. pycnostachya* (sect. *Suprago*) from Lamar Co., Texas, is described and named here as *L. ×johnsonii* M. White. A hybrid between *L. elegans* var. *elegans* (sect. *Liatris*) and *L. tenuis* (sect. *Vorago*) from Newton and Angelina counties, Texas, is described and named as *L. ×orzellii* Nesom. Documentation is provided for each hybrid.

**KEY WORDS:** *Liatris squarrosa*, *L. pycnostachya*, *L. elegans*, *L. tenuis*, hybrids, Texas

Two interspecific hybrids in *Liatris* have been observed in east Texas, neither of which has been previously reported, and in keeping with the tradition of providing names for *Liatris* hybrids, each is here formally identified with an epithet. Hybrids are not unusual in the genus, and “The evolutionary and taxonomic coherence of *Liatris* is supported by the apparent ease with which hybrids are formed between species” (Nesom 2005, p. 1306). Both examples reported here are intersectional hybrids, further emphasizing this coherence. A list of *Liatris* hybrids and their putative parents is at the end of the FNA treatment of the genus (Nesom 2006) and an infrageneric classification is given in Nesom (2005).

*Liatris ×johnsonii* M. White, hybrid nov. [*L. pycnostachya* Michx., sect. *Suprago* × *L. squarrosa* (L.) Michx. var. *glabrata* (Rydb.) Gaiser, sect. *Liatris*] **TYPE:** USA. Texas. Lamar Co.: ca 11 mi W of center of Paris, 0.73 mi N of jet of CR 35150 and CR 35020 to corner and then 0.19 mi NW, 33° 41' 38" N, 95° 46' 12" W, native *Sporobolus silveanus* prairie at the head of intermittent tributary stream of Maxey Creek, Parisian Silt Loam (Ressel 1979) atop the Bonham Formation, 7 Jul 2009, M. White 09-1 (BRIT).

Hybrid between *Liatris pycnostachya* and *L. squarrosa* var. *glabrata* and intermediate in morphology, especially in head size and arrangement and involucre bract shape. (Fig. 1, center).

The epithet (“johnsonii”) commemorates Johnny Johnson who, after purchasing the Lamar County property where this new hybrid grows, recognized it was native prairie and began working to reclaim it from the cedars and brush.

The hybrid was discovered in a native prairie growing with populations of *Liatris pycnostachya* (White 09-2, BRIT) and *L. squarrosa* var. *glabrata* (White 09-3, BRIT) and is clearly intermediate between the two species. At this site, hundreds of plants of *L. pycnostachya* grow mainly in the flatter open areas, while the relatively uncommon *L. squarrosa* var. *glabrata* is confined to a slope receiving afternoon shade. Only one or two individuals of *L. pycnostachya* were found within the population of *L. squarrosa* var. *glabrata*, one of which was very close to the hybrid.



Figure 1. *Liatris*  $\times$  *johnsonii* (center) and its parents: *L. squarrosa* var. *glabrata* (left) and *L. pycnostachya* (right). Photos from prairie west of Paris, Lamar Co., Texas. July 7 and 9, 2009.





Figure 2. *Liatris xjohnsonii*. Lamar Co., Texas. July 7, 2009. A single plant with two stems.



The single hybrid plant, which consisted of two stalks arising from a single corm (Fig. 2), was growing within a population of about 75 individuals of *Liatris squarrosa* var. *glabrata*. At first glance the hybrid appeared to be a much taller individual of var. *glabrata*. Closer inspection revealed that the heads are smaller with shorter, stiffly spreading, purple-tinged phyllaries and are more densely arranged around the stem, like *L. pycnostachya*, rather than mostly alternate, as in *L. squarrosa* var. *glabrata*. Compared to *L. pycnostachya* at the site, the heads are noticeably larger and not nearly so densely spaced, and the phyllaries are broader. The hybrid also is intermediate in other features, as noted in the comparison below, which corroborate the hypothesis of hybridity.

*Liatris squarrosa* var. *glabrata*

**Leaf margins** with a narrow, bright white, indurate-thickened band, **involucres** cylindro-campanulate, 18–22 × 6–9 mm, **phyllaries** in 5–7 series, apices erect, margins without a hyaline border, **florets** ca 28–30, **corolla** lobes hispid on adaxial surface, **pappus** bristles plumose, barbels 8–10 times longer than the bristle width.

*Liatris* × *johnsonii*

**Leaf margins** with a narrow, whitish, indurate-thickened band, **involucres** cylindro-campanulate, 9–11 × 7–8 mm, **phyllaries** in 5–6 series, apices spreading to slightly recurved, margins without a hyaline border, **florets** 18–19, **corolla lobes** sparsely hirsute to glabrate on adaxial surface, **pappus bristles** subplumose, barbels 2–3 times longer than the bristle width.

*Liatris pycnostachya*

**Leaf margins** green (without a white band) and not indurate-thickened, **involucres** campanulate-cylindric, 7–8 × 4–5 mm, **phyllaries** in 4–5 series, apices sharply recurving, distally dilated and petaloid, margins with a narrow hyaline border, **florets** 6, **corolla lobes** glabrous on adaxial surface, **pappus bristles** minutely barbellate, barbels shorter than the bristle width.

Nesom (2006) recognized two varieties within *Liatris squarrosa* but noted (p. 518) that “var. *glabrata* apparently is morphologically discontinuous from var. *squarrosa* where their ranges closely approach each other (but do not meet) in Texas, and they might be treated as separate species, especially in view of the treatment here of *Liatris compacta* [(Torr. & Gray) Rydb.] at specific rank.” *Liatris pycnostachya* also hybridizes with var. *squarrosa* and these two are the parents of a hybrid from southeastern Illinois, where only var. *squarrosa* occurs, although neither parent was identified to a rank below species. Mohlenbrock’s floristic treatment (2002) included both *L. squarrosa* var. *squarrosa* and *L. squarrosa* var. *hirsuta* (Rydb.) Gaiser (= *L. hirsuta* Rydb., “scattered in sw. Ill.”), but the presence of typical *L. hirsuta* was not confirmed for the state in the FNA study and it is assumed here that typical *L. squarrosa* was the parent.

*Liatris* × *ridgwayi* Standley, *Rhodora* 31: 37. 1929. TYPE: USA. Illinois. Richland Co.: E of Bethel Church, 26 Aug 1928, R. Ridgway 3265 (holotype: F, digital image!).

Standley (1929, p. 38) noted the following about the Illinois hybrid, which was found growing with both parents: “In characters it is intermediate between these two species, but in general appearance it resembles more closely *L. pycnostachya*. The spikes are less dense and have fewer heads than those of that species. The long bracts occurring in the upper part of the spike, the large heads, and the green squarrose outer phyllaries all suggest *L. squarrosa*, and the terminal head of the spike is very similar to a head of that species, except for its smaller size. The heads, of course have more numerous florets than in *L. pycnostachya*, and the pappus is about intermediate between the barbellate pappus of *L. pycnostachya* and the plumose pappus of *L. squarrosa*.”

***Liatis* × *orzellii*** Nesom, hybrid nov. [*L. elegans* (Walt.) Michx. var. *elegans*, sect. *Liatis* × *L. tenuis* Shinn. sect. *Vorago*] TYPE: USA. Texas. Newton Co.: ca. 2 mi E of Texas Hwy 87 at a point 0.3 mi S of Sabine Co. line, W side of valley of tributary N of Mill Creek, 31° 09' 47" N, 93° 42' 03" W, dry sandy cutover longleaf pine savannah, near Willis Formation and Catahoula Formation contact, elev. 330–350 ft, 25 Aug 1988, S. Orzell & E. Bridges 8273 (TEX).

Hybrid between *Liatis elegans* var. *elegans* and *L. tenuis* and intermediate in morphology, especially in involucre bracts and pappus.

Additional collection examined. USA. Texas. Angelina Co.: Angelina Natl. Forest, SW of Forest Service Rd 313 and FS Rd 313A, N of Boykin Spring Recreation Area, 31° 04' 27" N, 94° 16' 30" W, old-growth, burned, dry, upland longleaf pine savannah, Catahoula Formation, elev. 200–350 ft, 14 Aug 1989, Orzell & Bridges 11418 (TEX).

The collectors (Steve Orzell and Edwin Bridges) identified both of these collections as interspecific hybrids. Both hybrid plants are similar between themselves and both clearly show intermediate morphology between the two putative parents. Var. *elegans* is the only expression of *L. elegans* that grows at either site (Mayfield 2001). At the same site and date as the type collection, the collectors vouchered both parental species: *Liatis elegans* var. *elegans* (Orzell & Bridges 8272, TEX — perhaps slightly introgressed by *L. tenuis*, according to an annotation in 1994 by Mark Mayfield) and typical *L. tenuis* (Orzell & Bridges 8271, TEX — slightly different in ecology, Catahoula barrens below high hillside seepage bog). In documentation of the paratype hybrid, the collectors vouchered *Liatis elegans* var. *elegans* from the same site (Orzell & Bridges 11428) — perhaps slightly introgressed by *L. tenuis*, according to an annotation in 1994 by Mark Mayfield. Two years earlier, they had collected typical *L. tenuis* at exactly the same site: 10 Aug 1987, Orzell & Bridges 5614 (TEX).

*Liatis elegans* (sect. *Liatis*, ser. *Elegantes*) is a distinctive species in its foliaceous floral bracts with petaloid apices, and the hybrids with *L. tenuis* (sect. *Vorago*) show intermediacy in this feature. The pappus of the hybrids also is intermediate between *L. elegans* (plumose bristles) and *L. tenuis* (barbellate bristles). *Liatis tenuis* is similar to species of sect. *Liatis* in its “whitish, thickened, and minutely scabrous leaf margins, cylindric heads, and indurate and loose or spreading, subequal to weakly graduate, somewhat foliaceous, triangular phyllaries with acute to acuminate apices and without hyaline margins” (Nesom 2005, p. 1313), and “In the original description of *Liatis tenuis*, Shinn. (1959) noted its general similarity to *L. squarrosa* (ser. *Liatis*) but rejected a hypothesis of close relationship because of the disparity in pappus bristle morphology. Still, the weakly 3-veined leaves of *L. tenuis* suggest that it may be closest to species of ser. *Liatis*, perhaps as a sister element” (p. 1313).

#### *Liatis tenuis*

**Leaves** linear-lanceolate to linear-oblongate, 2–3(–5) mm wide; **involucre** cylindric-campulate, 10–13 mm long, **phyllaries** margins without hyaline borders, ciliate, apices mostly acute to acuminate, not dilated, green, **florets** 10–12, **pappus bristles** barbellate or proximally plumose

#### *Liatis* × *orzellii*

**Leaves** linear-lanceolate, 2.5–6 mm wide; **involucre** cylindric, 12–15 mm long; **phyllaries** margins with narrow, pinkish, hyaline borders, apices slightly or not dilated, abruptly acuminate, **florets** 6–7, **pappus bristles** subplumose Both collections of the hybrid are very similar between themselves, in 11418, the heads of the inflorescence widely spaced and the pappus bristles are subplumose, intermediate between the two parents; in 8273, the heads of the inflorescence are more densely arranged and the pappus bristles are more nearly barbellate, more like *L. tenuis*.

*Liatris elegans*

**Leaves** narrowly oblanceolate, 3–8 mm wide; **involucres** turbinate-cylindric, 12–20 mm long; **phyllaries** margins with hyaline borders, apices (at least inner) prolonged, ± dilated, petaloid (pink, purplish, white, or yellow), **florets** 4–5, **pappus bristles** plumose.

*Liatris elegans* var. *elegans* is the putative parent in another interspecific hybrid, *Liatris* × *boykinii* Torr. & Gray (Fl. N. Amer. 2(1): 70. 1841), a cross with *L. tenuifolia* Nutt. (sect. *Pilifilis* Nesom), described from near Columbus, Georgia. Gaiser (1951) noted that another collection from Georgia (Sumter Co.: Harper 635, NY, US, as cited) is similar to *L. ×boykinii* and was noted by its collector to be intermediate between *L. elegans* and *L. tenuifolia*. *Liatris elegans* var. *carrizana* Gaiser, an endemic of east Texas, is the putative parent in two hybrid crosses, one with *L. pycnostachya* (sect. *Suprago*) and one with *L. punctata* Hook. (sect. *Liatris*). Both hybrids were discovered and vouchered in 1992 (TEX) by Mark Mayfield.

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## A NEW SPECIES OF *EUCNIDE* (LOASACEAE) FROM CHIAPAS, MEXICO

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### ABSTRACT

A new taxon, *Eucnide chiapasana* B.L. Turner, sp. nov., is described from the Tropical Deciduous Forest of Chiapas, Mexico. It is presumably most closely related to the more arid, *E. hypomalaca*, a species of the Sonoran Desert. A photograph of the holotype is provided, along with maps showing distributions of the taxa concerned.

**KEY WORDS:** Loasaceae, *Eucnide*, *Eucnide hypomalaca*, *Eucnide arida*, Mexico, Chiapas

Routine identification of Mexican plants has brought to light a previously undescribed species of *Eucnide*. Thompson and Ernst (1967) provided an excellent treatment of the genus, but unfortunately, none of the specimens of the present novelty was available at the time of their study. In their key to species the taxon will key to or near *E. hypomalaca* Standl., a species of the Sonoran Desert (Fig. 2). The two taxa differ in numerous morphological characters.

**EUCNIDE CHIAPASANA** B.L. Turner, sp. nov. Figure 1. **TYPE:** MEXICO. Chiapas. Mpio. Chiapa de Corzo, at the Río Grijalva, 10 km W of Chiapa de Corzo along Mexican Highway 190, edge of cliff, Tropical Deciduous Forest, 500 m, 24 Feb 1973, D.E. Breedlove 33828 (holotype: TEX; isotype: CAS).

Resembling *Eucnide hypomalaca* Standl. but the leaves more nearly cordate with much broader blades (10–15 cm wide vs 3–6 cm), peduncles densely pubescent with numerous elongate, non-peltate hairs 1–2 mm long (vs mostly peltate and ca 1 mm long); anthers 4-sided, ca 1.5 times as long as wide (vs reniform to ovoid and as long as wide), minutely pubescent when first formed (vs not so).

**Suffruticose perennial herbs** to 30 cm high. **Mid-stems** 5–7 mm thick, densely pubescent with long, acicular trichomes, 1–2 mm long, beneath these a more densely array of short peltate hairs. **Leaves** at mid-stem (10–)15–20 cm long, 8–15 cm wide; petioles (3–)6–10 cm long; blades cordate (rarely not), pinnately nerved, pubescent above and below like the stems, the margins with ca 9, broadly rounded, lobes, the sinuses 0.5–1.0 cm deep. **Flowers** 6–9 in terminal congested racemes 6–10 cm long, and as wide; peduncles relatively short, 1–2 cm long. **Sepals**, 1–2 cm long, 4–5 mm wide. **Corollas** reportedly white or “pale yellow” (Neill 5515), the petals 3–4 cm long, 1.5–2.0 cm wide, united at base for ca 2 mm. **Stamens** numerous (ca 200 or more), mostly exceeding the petals in length; anthers somewhat quadrate in shape, ca 1 mm long, 0.75 mm wide; young anthers minutely pubescent with glandular hairs, these shedding with age. **Fruits** obpyramidal, ca 1.5 cm long, 1.3 cm wide, densely pubescent like the stems; seeds ca 1 mm long.

**Additional specimens examined.** MEXICO. OAXACA. Mpio. Chiapa de Corozo, steep bank of Río Grijalva along Mexican Hwy 190 between Chiapa de Corzo and Tuxtla Gut, 300 m, 3 Dec 1971, Breedlove 22956 (CAS). Mpio. Ocozacoautla de Espinosa, head of the Río de la Venta, near Derna, 800–1000 m, 3 Dec 1971, Breedlove 27401 (CAS); same locality, 24 Dec 1976, Breedlove 42864 (CAS); same locality, 11 Oct 1979, Breedlove 44383 (CAS); same locality, 16 Dec 1972,



Figure 1. *Eucnide chiapasana* B.L. Turner (holotype, TEX).

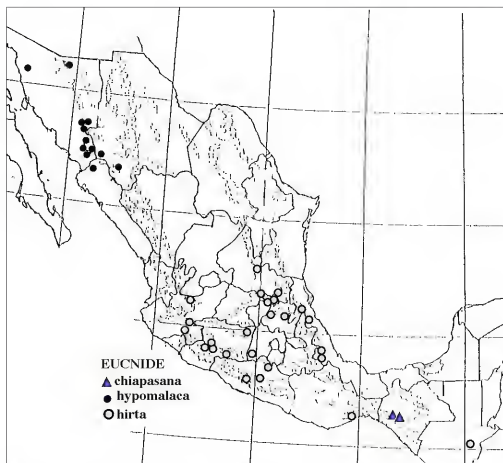


Fig. 2 Distribution of *Eucnide chiapasana*, *E. hirta*, and *E. hypomalaca*

*Breedlove & Thorne 30302* (CAS), steep walled limestone canyon of Río de Venta near Cascada El Aquacero, 15 km W of Ocozucuaúta on Hwy 190, then 3 km N, 12 Mar 1983, *Neill 5515* (CAS).

*Eucnide chiapasana* is a very distinct species, as noted in the diagnosis. Hufford (1988) annotated all of the specimens cited above as *E. hypomalaca*, these similar to the latter in habit and flower size. The novelty is also superficially similar to the widespread and quite variable *E. hirta*, the latter readily distinguished by its narrow corollas and much fewer stamens. Distribution of all three taxa is shown in Figure 2.

A notable trait of *Eucnide chiapasana* is the anthers, which are elongate-quadrate, resembling the head of a rattlesnake when young, and possessing minute hairs that are deciduous with maturity. Such hairs were found on both of the types. The young anthers of *E. hypomalaca* are essentially ovoid and glabrous.

Hufford (1988) has provided a scanned electron micrograph of the seed from the isotype of *Eucnide chiapasana* (his Figs. 19 and 20, which are labeled as *E. hypomalaca*).

The species is named for the state of Chiapas, Mexico, to which it seems confined (Fig. 2).

#### ACKNOWLEDGEMENTS

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## A NEW COMBINATION IN *CHUSQUEA* (POACEAE: BAMBUSOIDEAE)

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### ABSTRACT

A new combination, *Chusquea glomerata* (Swallen) Dorr, is proposed for *Neurolepis glomerata* Swallen, a species of bamboo with a disjunct distribution in the Venezuelan Guayana and northern Andes.

**KEY WORDS:** Bambusoideae, *Chusquea*, Poaceae

Fisher et al. (2009) concluded that chloroplast genomes indicate probable parphyly of the genus *Neurolepis* Meisn. (1843) with respect to *Chusquea* Kunth (1822) (Poaceae: Bambusoideae). In the same paper, Clark transferred the species of *Neurolepis* to *Chusquea* and proposed a score of new combinations and new names. Both genera have been collected in Guaramacal (Dorr et al., 2000), a national park in the Andes of Venezuela, and as a treatment of the grasses is being finalized for a flora of this area (Dorr et al., in prep.) the names of the bamboo species present in the park were reviewed. In that review it was discovered that a nomen novum proposed in *Chusquea* for *N. glomerata* Swallen was superfluous.

Clark in Fisher et al. (2009) proposed “*Chusquea steyermarkii* L.G. Clark, nom. nov.” to replace *Neurolepis glomerata*, as she presumably concluded that a new combination was precluded by “*Chusquea glomerata* Munro.” However, this name has no nomenclatural standing, as Munro (1868) merely cited “*Chusquea (Retbergia) glomerata*, Munro in herb. Trin. Coll. Dublin” as a synonym of *Merostachys capitata* Hook. (= *Athrostachys capitata* (Hook.) Benth.). Furthermore, if a combination based on *N. glomerata* had been blocked, there still would not have been a need to propose a nomen novum, because either one of the two heterotypic synonyms, *N. nigra* Swallen or *N. densiflora* Swallen, that Clark in Fisher et al. (2009) cited was available to serve as a basionym for a new combination in *Chusquea*.

Consequently, the correct name (and synonymy) for *Neurolepis glomerata* in *Chusquea* is this:

***Chusquea glomerata*** (Swallen) Dorr, comb. nov. Basionym: *Neurolepis glomerata* Swallen in Maguire et al., Mem. New York Bot. Gard. 9: 399. 1957. *Chusquea steyermarkii* L.G. Clark in A.E. Fisher et al., Syst. Bot. 34: 681. 2009, nom. superfl. **TYPE:** Venezuela. Bolívar: Chimantá Massif, *Bonnetta* forest, northwestern part of summit of Abácapa-tepui, 2125–2300 m, 13 Apr 1953 (fl), J.A. Steyermark 74925 pro parte (holotype: US-2182879; isotypes: F-2 sheets, MO-fragment, NY, US-2182878; probable isotype: US-2182881!).

*Chusquea glomerata* Munro, Trans. Linn. Soc. London 26(1): 50. 1868, nom. nud., pro syn.

*Neurolepis densiflora* Swallen in Maguire et al., Mem. New York Bot. Gard. 9: 399. 1957. **TYPE:** Venezuela. Bolívar: Chimantá Massif, lower mixed *Bonnetta* forest above southeast-facing upper shoulder on slope leading to summit of Apácará-tepui, 2000–2150 m, 20 Jun 1953 (fl), J.A. Steyermark 75806 (holotype: US-2 sheets!; isotypes: F, NY).



*Neurolepis nigra* Swallen in Maguire et al., Mem. New York Bot. Gard. 9: 400. 1957. TYPE: Venezuela. Bolívar: Chimantá Massif, Central Section, open forested laterite slopes along tributary of east branch of headwaters of Río Tirica, 2185–2210 m, 13 Feb 1955 (fl), J.A. Steyermark & J.J. Wurdack 860 (holotype: US-3 sheets!; isotypes: NY-3 sheets).

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## ***PINUS CLAUSA* (PINACEAE) ADVENTIVE IN TEXAS**

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### **ABSTRACT**

An adventive population of *Pinus clausa*, sand pine, is reported in the Post Oak Savanna of Henderson County, Texas. About 25–30 individuals are present at the site but there is no evidence of how they arrived.

**KEY WORDS:** Pinaceae, *Pinus clausa*, *Pinus*, adventive, Post Oak Savanna, Texas, U.S.A.

*Pinus clausa* (Chapm. ex Engelm.) Vasey ex Sarg., sand pine, is a fire successional in sandy dunes and sandhills (Kral 1993). The species was mapped as native and endemic to Florida (central peninsula and western part of the panhandle) and adjacent Baldwin Co., Alabama (Little 1978). USDA, NRCS (2012) also included Pike County in the Alabama distribution, but without comment. The Mississippi Natural Heritage Program cites the species as native to Jackson County of that state (Mississippi Museum of Natural Science 2007). Weakley (2011) mentions that the species is “widely planted in pulp plantations in FL and s. GA, experimentally planted as far north as NC.” Duncan and Duncan (1988) reported the species is “reproducing naturally in s GA.” The species is not an important timber tree because of small size (up to 21 m tall) and profuse branching, but it is important for pulpwood production (Kral 1993).

Based upon the specimen cited below, *Pinus clausa* is reported here as adventive to Texas. Approximately 25–30 reproductive individuals (serotinous cones) of *Pinus clausa* were present at the site, these being from 20–30 cm diameter at breast height (ca. 137 cm) and 7–9 m tall. Based on site descriptions and silvics of natural stands in Florida (Schumacher & Coile 1960; USDA, USFS 1965) and other engineered stands (Burns 1978; Hebb 1982) upper age estimates at this Texas site were determined to be about 35–40 years of age, with other age classes occurring. Seedlings were interspersed among the age classes, but there was no evidence as to how the plants may have arrived.

Voucher specimen. Texas. Henderson Co.: Clements Scout Ranch, 0.3 mi. N of jct. of FM 2970 and Co Rd 1116 on FM 2970, E through entrance of camp 0.1 mi., then NE on sand road 0.3 mi. (32° 5'51.46"N, 95° 53'38.50"W), deep sandhills, 27 Sep 2006, Jason R. Singhurst & Edwin Bridges 16031 (BAYLU). Figs. 1–3.



Figure 1. Close-up of *Pinus clausa*. Voucher with serotinous ovulate cone. (Singhurst & Bridges 16031, BAYLU)

The specimen is from the Post Oak Savanna and area of deep sands located to the west of the Pineywoods of deep east Texas. This savanna can generally be characterized as a *Quercus stellata*—*Q. marilandica* overstory and an understory of grass, chiefly *Schizachyrium scoparium* (in Diggs et al. 2006). At this locale *Quercus incana* was a common overstory species. The area of occurrence was void of other woody plants and dominated by *Aristida desmantha*, *Croptilon divaricatum*, *Eriogonum multiflorum*, *Liatris elegans* subsp. *bridei*, *Matelea cynanchoides*, *Paronychia drummondii*, *Polanisia erosa*, *Penstemon murrayanus*, *Rhododon ciliatus*, and *Triplasis purpurea*.

Because of the short needles (to 10 cm long), *Pinus clausa* would key to *P. echinata* Mill. in Correll and Johnston (1970) and Diggs et al. (2006). This similarity is superficial, however, as *P. clausa* is said to be more closely related to *P. virginiana* Mill., *P. banksiana* Lamb., and the *P. contorta* Douglas ex Loudon complex (Weakley 2011). *Pinus clausa* and *P. echinata* may be distinguished by use of the following key, which is adapted from Duncan and Duncan (1988), Kral (1993), and Wunderlin (1998).

- |  |                              |
|--|------------------------------|
| 1 Twigs roughened and cracking below leafy portion, bark plates with evident resin pockets, leaves mostly ca. 1 mm wide, tips of seed cone scales without a conspicuous horizontal ridge, inconspicuous light-colored band located distally on adaxial surface of ovulate scales | <b><i>Pinus echinata</i></b> |
| 1 Twigs smooth below leafy portions, bark plates lacking resin pockets, leaves mostly 0.5–less than 1 mm wide, tip of seed cone scales with a conspicuous horizontal ridge, conspicuous dark red-brown to purple band located distally on adaxial surface of ovulate scales      | <b><i>Pinus clausa</i></b>   |

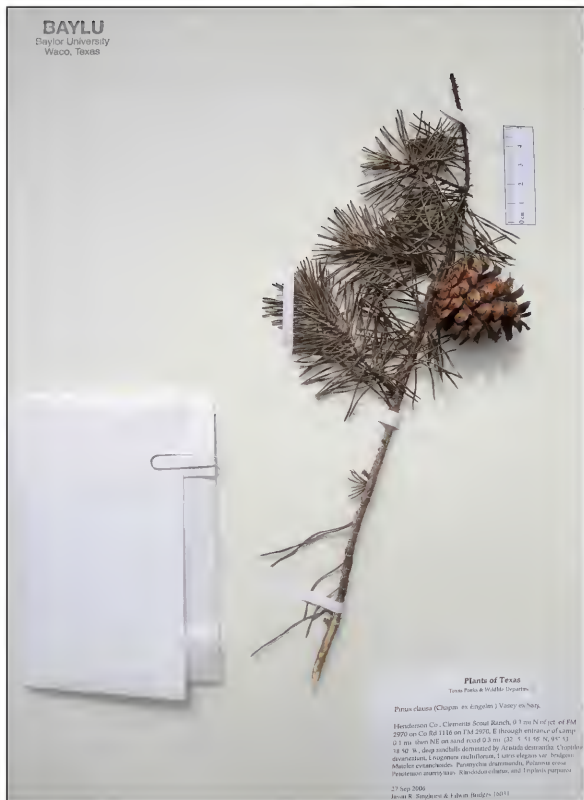


Figure 3. *Pinus clausa* Henderson Co., Texas (Singhurst & Bridges 16031, BAYLU)



Figure 2. Adaxial aspect of *Pinus clausa* ovulate scales. (Singhurst & Bridges 16031, BAYLU).

*Pinus clausa* is the second species of the genus known to be introduced to east Texas, the other being *P. elliotii* Engelm. (Diggs et al. 2006). *Pinus echinata* Mill., *P. taeda* L., and *P. palustris* Mill. are native east Texas pine species.

#### ACKNOWLEDGEMENTS

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A NEW SPECIES OF *SCROPHULARIA* (SCROPHULARIACEAE)  
FROM NORTHEASTERN MEXICO

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ABSTRACT

A new species from the mountains of northeastern Mexico is described and illustrated: *Scrophularia mexicana* Mayfield & Nesom. The new species is compared to the more widely distributed *S. marilandica* from the eastern USA, from which it is geographically separated by more than 700 kilometers.

*Scrophularia* L. in North America is represented by 11 native and at least one introduced species, as currently considered (e.g., Hitchcock & Cronquist 1973; Martin & Hutchins 1981; Gleason & Cronquist 1991; Wetherwax 1993; Kartesz 1999). *Scrophularia marilandica* L. is the only species restricted to the eastern USA. and adjacent Canada (west to northeastern Texas and Oklahoma). *Scrophularia lanceolata* Pursh also occurs in the eastern USA but is distributed sporadically from coast to coast in the northern half of the USA and southern Canada. The remaining North American species occur from the southern Rocky Mountains to California, Washington, and British Columbia. Among the native North American species, *S. californica* Cham. & Schlecht. and *S. villosa* Pennell are the only ones known to occur naturally in Mexico, each represented there by southward range extensions.

Here we describe a new species known only from a single population in the mountains of Nuevo León, about 30 kilometers (air) northwest of Victoria, Tamaulipas. The new species is geographically separated from the closest known populations of any *Scrophularia* species (*S. marilandica*) by more than 700 kilometers.

***Scrophularia mexicana*** Mayfield & Nesom, sp. nov. (Figs. 1, 2, and 3). **TYPE:** MEXICO. Nuevo León. Mpio. Aramberri, along the road to Dulces Nombres, Nuevo León, from Sta. Engracia, Tamaulipas, 36 road miles from Sta. Engracia, at the road crossing of the deep canyon of Arroyo Ramirez Luna, riparian association of *Juglans mollis*, *Carya palmeri*, *Quercus rysophylla*; *Scrophularia* scattered and uncommon along gravel bars of stream with thick herbaceous vegetation, 1390 m, 23° 58' 13" N, 99° 31' 12" W, 22 Sept 1994, Guy Nesom 7474 with Mark Mayfield (holotype: MEXU; isotypes: TEX, US).

Similar to *Scrophularia marilandica* L. but different in its villous-glandular stems, smaller leaves with shorter petioles, and narrowly oblanceolate staminodes with acute apices.

Figure 1. *Scrophularia mexicana*, isotype (TEX).



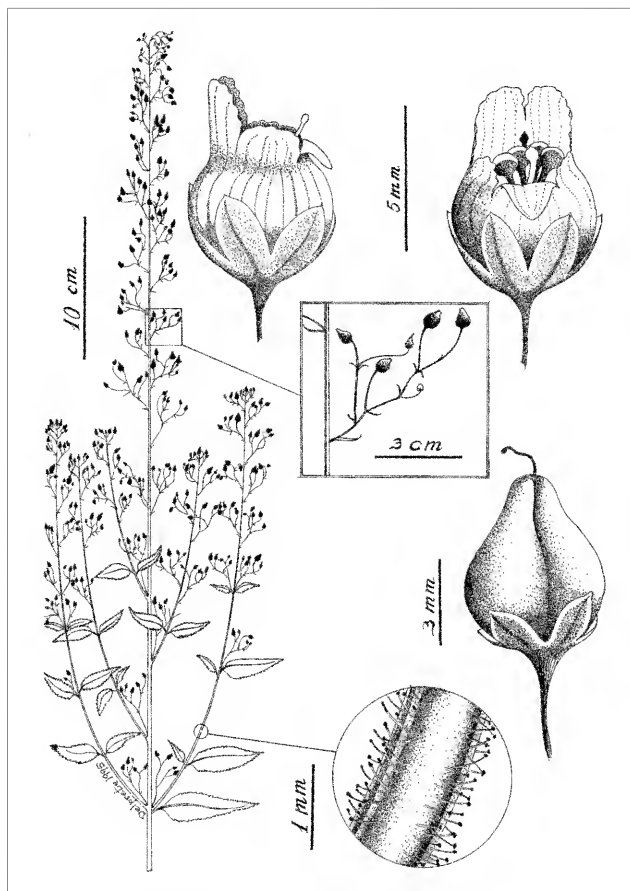


Figure 2. Upper stem habit, ventral and lateral view of flower, inflorescence branching, capsule, and stem vestiture of *Scrophularia mexicana*.

**Stems** 1.0–1.4 m tall, erect, squared in cross-section, the angles rounded, villous in the inflorescence and at least to midstem with simple and gland-tipped hairs (0.1–)0.2–0.8(–1.0) mm long, the trichomes vitreous, shortest along the axis of the inflorescence. **Leaves** blades (mid to upper stems) ovate with acute apex and obtusely rounded to broadly subacuminate at base, 4–7 cm long, 2–4 cm wide, the margins crenate-serrate, petioles 5–15 mm long, somewhat flattened laterally.

**Inflorescences** apical and solitary at the tips of the several branches and mainstem, each consisting of a raceme of diffusely branched, ascending cymes, the primary branches divergent and slightly ascending. **Corollas** broadly cylindric to subglobose, 7–8 mm long, reddish-brown, the lower lip light-green, staminode (sterile filament) dark purple, the free portion ca 1.5 mm long, oblancoolate, 0.4–0.5 mm wide at the widest point, acute- to subacute-deltoid at the apex. **Capsules** 5–6 mm long, ovoid to pyriform, apically blunt or slightly depressed, greenish-brown, somewhat lustrous. **Seeds** ca 1 mm long, black, rugose. Known only from the type collection.

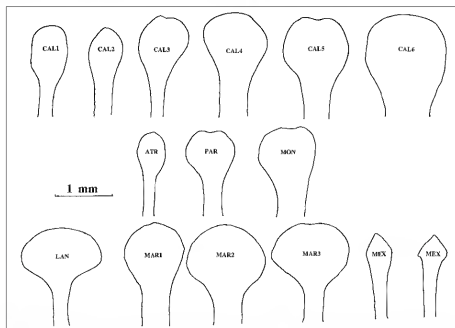


Figure 3. Variation in terminal portions of staminodes of *Scrophularia* species. Top line CAL = *S. californica* sensu lato (including var *californica*, var *floribunda*, *S. oregana*, and *S. desertorum*). Middle line. ATR = *S. atrata*, PAR = *S. parviflora*, MON = *S. montana*. Bottom line. LAN = *S. lanceolata*, MAR = *S. marilandica*, MEX = *S. mexicana*.

The cauline vestiture of long, vitreous, glandular trichomes (Fig. 2) and narrow, acute staminodes (Fig. 3) are the most divergent features that distinguish *Scrophularia mexicana* from other North American members of the genus. The new species is compared here to the widespread *S. marilandica* not because of direct evidence of close relationship but because it is the geographically closest *Scrophularia* species and because biogeographical considerations suggest a possible close relationship between them (see comments below). The key differences between *Scrophularia mexicana* and *S. marilandica* are summarized in the following couplet.

1. Stems minutely glandular in the inflorescence, trichomes mostly less than 0.1 mm long; free portion of the staminode spatulate, blunt and rounded apically, 1.2–1.8 mm wide; blades of upper stem leaves mostly (6–) 8–15 cm long, the petioles 10–20(–25) mm long  
..... *Scrophularia marilandica*
1. Stems villous-glandular in the inflorescence and at least to midstem, the glandular trichomes (0.1–) 0.2–0.6(–1.0) mm long; free portion of the staminode oblanceolate and apically acute, 0.4–0.5 mm wide; blades of upper stem leaves 4–7 cm long, the petioles 5–15 mm long  
..... *Scrophularia mexicana*

Although the western species of *Scrophularia* have been studied comparatively (Shaw 1962), all of the North American species have yet to be considered within a single study, which we believe will emphasize the close vegetative similarities between *S. californica* sensu stricto, *S. marilandica*, and *S. mexicana*. All three of these species share a rather uniform glandular pubescence, basally rotund leaves with evenly serrate margins, and tend to have spreading diffuse inflorescences. None of these characters, however, is invariant within a species.

*Scrophularia mexicana* shares no unequivocally derived features with any other species or group of species of North America that would suggest a phyletically coordinate relationship. Most keys emphasize the staminode morphology in distinguishing some of the paired species, an indication that this character may be more consistent than others. The staminodia of *S. mexicana* are unique in having the free portion more elongate, much narrower, and more acutely apiculate than all other North American species. Nevertheless, the floristic relationship between the eastern and southeastern United States and the Sierra Madre Oriental of Mexico is well known and demonstrated by numerous species pairs and disjunctions within species (see Nesom and Mayfield 1995 for examples and discussion). A hypothesis that *S. mexicana* and *S. marilandica* are closely related is consistent with this biogeographical phenomenon as well as the morphology.

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## IDENTIFICATION OF EASTERN NORTH AMERICAN *MORUS* (MORACEAE): TAXONOMIC STATUS OF *M. MURRAYANA*

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### ABSTRACT

Recent recognition of a new species of *Morus* (*Morus murrayana* D.E. Saar & S.J. Galla) from eastern North America highlights a general misapplication of the characters that discriminate the native *M. rubra* and the morphologically and ecologically variable introduced species *M. alba*. Morphological and molecular data presented here show that *M. murrayana* is best treated as a synonym of *M. rubra*, well within its range of morphology and sexual expression. Salient features of *M. alba* and *M. rubra* are presented in order to clarify the distinctions among these species.

**KEY WORDS:** Moraceae, *Morus alba*, *Morus murrayana*, *Morus rubra*

Two species of *Morus* L. (mulberry) occur in eastern North America (Wunderlin 1997). The native *M. rubra* L. ranges throughout much of the eastern United States — from the Edwards Plateau of Texas and north in the eastern Great Plains, to southern New England and the southern extreme of Ontario, Canada (Parks Canada Agency 2011), and south to northern Florida (Wunderlin 1982). It occurs in rich, circumneutral soils in native forested land and is now considered rare and threatened in many areas, particularly in the northeastern United States and southeastern Canada (United States — see USDA, NRCS 2012; Canada — Ambrose & Kirk 2004, Penskar 2009, Parks Canada Agency 2011). The introduced *M. alba* L., native to China, was established in North America during colonial times and is now naturalized and often invasive throughout most of the range of *M. rubra* (Wunderlin 1997). It has broad ecological amplitude, occurring in forests and open areas alike (and it continues to be commonly cultivated). The two species are known to hybridize where they co-occur (Burgess et al. 2005; Burgess & Husband 2006; see also Salah, 2006; Nepal 2008), with *M. alba* posing a potential threat to conservation of the native species. These species are generally easily distinguished in the field, but the recent description of *M. murrayana* highlights confusion often encountered when discriminating among them.

Students of dendrology commonly encounter the “weedy” *Morus alba* but ironically may be less familiar with the native *M. rubra*. Because *M. alba* thrives in a variety of habitats and exhibits much morphological variation, workers may — and commonly do — mistakenly identify variants within *M. alba* as the native *M. rubra*. Herein, we analyze the evidence used to support recognition of a new species of *Morus* — the recently described *M. murrayana* (Galla et al. 2009). We purport that *M. murrayana* and *M. rubra* are taxonomic synonyms and that recognition of the new species

resulted from the authors' failure to understand the identity of the type of *M. rubra*. Their misconception further led to misinterpretation of their molecular data (discussed below). Our taxonomic position with respect to *M. murrayana* is also supported by the available taxonomic information on these species (including the Flora of North America North of Mexico [FNA] treatment by Wunderlin [1997], with which we concur). We think this clarification is critical and urgent because *M. rubra* is a species of conservation concern (see Parks Canada Agency 2011) and because of the potential for further propagation of a broad, multifaceted misunderstanding of its taxonomy. The present contribution is intended to serve primarily as an aid to proper identification of eastern North American *Morus* and to promote further study of these species.

### ***Morus murrayana* is fairly typical *M. rubra***

Identification of *Morus alba* and *M. rubra* is complicated by intraspecific variation in these species, coupled with contemporary abundance of the introduced species. For example, leaf size, lobing, and vestiture are highly variable within both species and must be properly contextualized when used as criteria for taxonomic recognition (see Britton & Brown 1913; Radford et al. 1968; Gleason & Cronquist 1991; Mohlenbrock 2002). Fruit color (a character highlighted by common names and sometimes employed by the layperson) is highly variable within *M. alba* and non-diagnostic. In fact, in wild populations, fruits of *M. alba* are usually red to black rather than white. Breeding system variation has also caused confusion. In describing *M. murrayana*, Galla et al. (2009) state that “Trees produce either predominately staminate or carpellate inflorescences, but the presence of some staminate inflorescences on carpellate trees and vice-versa is common. ... Both staminate and carpellate inflorescences may occur on the same large branch, usually separated on different twigs.” They suggest, by contrast, that *M. rubra* is consistently monoecious. In fact, breeding system has generally not been carefully documented in North American *Morus* species and is intriguing. Despite wide reports of monoecy in *M. rubra*, our observations for this species in Kansas are corroborated by the description in Galla et al. (for *M. murrayana*, quoted above). We have found populations of both *M. alba* and *M. rubra* in the eastern Great Plains to be subdioecious, with the majority of individuals producing catkins of a single sex but with some (ca. 10%) being hermaphrodites (Nepal 2008 and unpubl.). The lectotype of *M. rubra* includes two separate branches, one with only staminate inflorescences and another with one twig bearing staminate inflorescences and another bearing carpellate inflorescences (Fig. 1).

The primary character emphasized by Galla et al. (2009) in support of their initial recognition of a new species (*Morus murrayana*) was large leaf size (>15cm). The authors further noted that Wunderlin's (1997) description of *M. rubra* in FNA mostly encompasses the larger leaf size of *M. murrayana*. In addition, they state that “[*M. murrayana*] ... can be distinguished from *M. rubra* based on leaf vein pattern ... leaves longer than 15 cm with caudate tips (vs. leaves <15 cm with cuspidate to broadly acute or acuminate tips), and fruits longer than 3 cm (vs. ≤3 cm).” These features are congruent with the type of *M. rubra* (Fig. 1), and, in our experience, with the morphology of typical individuals of *M. rubra* from across the range. It is likely that larger leaves are under-represented in herbarium collections because leaves near flowering material are typically smaller and larger leaves may also be avoided by collectors. Overall, the details of the shape, vestiture, margins, and venation of leaves (rather than overall size) provide the most distinctive aspects of the leaves. The typical unlobed leaf of *M. rubra* is well represented by Figure 2C (*M. murrayana*) of Galla et al. (2009; p. 108). Most characteristic (*M. rubra*-like) are the drawn out “caudate” apices, closed venation, and smaller, more numerous, marginal teeth, features that are typically utilized in keys for *M. rubra* based on leaf morphology (e.g., Britton & Brown 1913; Gleason & Cronquist 1991; Wunderlin 1997). We have not been able to access type material of *M. murrayana* (isotypes noted by Galla et al., 2009 have not been distributed). However, consideration of the description and illustration of *M. murrayana* (coupled with molecular data; see below) indicate that it is truly *M. rubra*.



Figure 1. *Morus rubra* lectotype (LINN 1112.6, Reveal 2007) image reproduced by the permission of the Linnaean Society of London. The upper branch and right side portion of the lower branch bear staminate inflorescences, while the left side portion of the lower branch bears carpellate inflorescences.

Galla et al. (2009) rightly highlight the value of field study (they studied plants directly in the field in Kentucky), but fieldwork cannot take the place of careful comparative study of herbarium



### Salient features for correct identification of *M. alba* and *M. rubra*

*Morus rubra* can be easily distinguished from *M. alba* using morphological characters of the leaf, bud, branch, bark and infructescence. Leaf characters present a challenge because of the tendency for leaves of juvenile shoots to converge in morphology among these species. Nearly all of the unique characteristics of *M. rubra* fail in juvenile leaves. Leaves of *M. rubra* (5–40 × 3–28 cm) are larger overall than those of *M. alba* (2–20 × 1.5–18 cm). In *M. rubra* leaves, the adaxial (upper) surface is rough and dull green (vs. smooth and lustrous) and the abaxial (lower) surface is usually densely hairy with erect trichomes evenly distributed (soft to the touch); the base is often cordate (heart-shaped); the apex is acute, acuminate to subcaudate; marginal teeth are often pointed; and the color of the main veins is more or less like the color of the lamina on the underside. Leaves of *Morus alba* are usually deep green and lustrous adaxially and have few hairs concentrated along the main veins on the abaxial surface; the base is rounded (vs. cordate); the apex is obtuse; the marginal teeth are fewer, relatively larger, and rounded; and the primary veins (underside) contrast more with the leaf surface than in *M. rubra*. The winter buds of *M. rubra* have bud scale margins with a darker (almost black) apical band, while in *M. alba*, the bud scale margins are uniformly brown. *Morus rubra* has grayish bark with flattened, thin plates that peel outwards in age. *Morus alba* bark has thick and solid ridges that are more of a reddish tan coloration. The orientation of branches in a mature *M. rubra* is somewhat planar (flat) and spreading like an umbrella. In *M. alba* the orientation of branches is more erect or spreading, and the plants appear more rounded or bushy as a result. The fruit of *M. rubra* is longer and narrowly cylindric, while in *M. alba* it is typically ovoid or ellipsoid.

### Opportunities for future study

There is no question that *Morus* exhibits intriguing morphological variation in eastern North America, and further study is warranted. Patterns of intraspecific variation as well as effects of interspecific hybridization between *M. alba* and *M. rubra* warrant additional morphological and ecological scrutiny. We are encouraged to know that colleagues are exploring these issues (D. Saar, pers. comm.; Salah 2006; A. Whittemore, pers. comm.). We hope the present contribution clarifies the identities of the species *M. alba* and *M. rubra* in North America and spurs additional work on these taxa.

### ACKNOWLEDGEMENTS

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***IPOMOEA DIRIADACTYLINA* (CONVOLVULACEAE), A NEW SPECIES FROM THE  
NICOYA PENINSULA, COSTA RICA**

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**ABSTRACT**

*Ipomoea diriadactylina* Hammel (Convolvulaceae), a new white-flowered species with bilobed stigmas and marginally lanate seeds, is described from an isolated ridge on the Nicoya Peninsula of Costa Rica. This publication provides a name for the species treated as *Ipomoea* "sp. A" in the *Manual de Plantas de Costa Rica*. The species is somewhat similar to the locally sympatric *I. batatoides* and *I. lindenii*, both of which can have white or greenish white corollas of similar size and shape, and lanate seeds. From both, and from all their known relatives, the new species differs strikingly by its large, persistent bracts and by its indistinctly mucronate sepals that (in life) become markedly convex in fruit, resembling fingers or claws.

**RESUMEN**

*Ipomoea diriadactylina* Hammel (Convolvulaceae), una especie nueva con flores blancas, estigmas bilobulados, y semillas marginalmente lanosas, se describe de una fila aislada en la Península de Nicoya de Costa Rica. Esta publicación provee un nombre para la especie tratada como *Ipomoea* "sp. A" en el *Manual de Plantas de Costa Rica*. La especie es algo parecida a las localmente simpátricas *I. batatoides* e *I. lindenii*, ambas que pueden tener las corolas blancas o blanco verdusco y de similar tamaño y forma, y tienen semillas lanosas. De ambas, y de todas las especies relacionadas conocidas, la especie nueva difiere notoriamente por sus brácteas grandes persistentes y por sus sépalos indistintamente mucronados que (en vivo) se vuelven marcadamente convexos en el fruto, con apariencia de dedos o garras.

**KEY WORDS:** Convolvulaceae, Costa Rica, *Ipomoea*, Nicoya Peninsula.

*Ipomoea* is a large genus with upwards from 650 species worldwide, over half of them from the New World (Austin & Huáman 1996). Many of the species, however, are wide-ranging. Although *Ipomoea* is quite large even in Costa Rica — *I. diriadactylina* becomes the fifty-second species known from the country — only eight other species names still considered to belong to *Ipomoea* were originally described from Costa Rica. *Ipomoea amparoana* Pilg., said to be related to *I. squamosa* Choisy (= *I. moreletii* Duchass. & Walp.) and described from cultivated material with no type designated nor yet found, is by its protologue most likely a synonym of *I. carnea* Jacq. (Hammel, in prep.). That assumed, of those eight names just one, *I. magniflora* O'Donnell (known only from the type), has not been relegated to synonymy. Thus, the present new species, so far known only from a few plants along an isolated ridge on the Nicoya Peninsula, is only the second endemic *Ipomoea* for the country.

***Ipomoea diriadactylina* Hammel, sp. nov. TYPE: COSTA RICA. Guanacaste. Cantón Santa Cruz. Dist. Santa Cruz: Rumbo a Vista al Mar por P. N. Diríá, ca. 200 m N de las primeras antenas, 10° 08.5' N, 85° 37.8' W, 800 m, 6 Nov 2009, B. Hammel & I. Pérez 25480 (holotype: MO; isotypes: ARIZ, CR, F, INB, MEXU, P, TEX, US). Figures 1–4.**

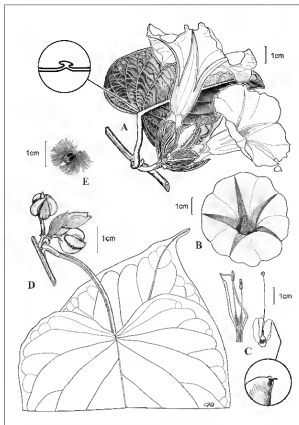


Figure 1. *Ipomoea durandactylina*. A, habit with flowers and close up of cross section of leaf midrib, lower surface of blade, B, front view of corolla, C, section of flower showing two of the five stamens attached to corolla and pistil with close up of tip of sepal, D, habit with nearly mature fruits showing calyx of markedly convex sepals, E, seed. Drawn by Claudia Aragon. A-C from the type, D from Hammel & Perez 24989, E from Hammel & Perez 25026.

This species is similar vegetatively and in its marginally lanate seeds to *Ipomoea batatoides* Choisy and in its short peduncles and pedicels to *I. lindeni* M. Martens & Galeotti — the new species can be distinguished from both of those and all their known relatives by its large and persistent inflorescence bracts and by its calyx of large sepals that almost completely encompass the mature fruit and in life are strongly convex, giving the appearance of the fruit being held in claws or fingers.

**Plants** suffruticose perennial vines or lianas. **Stems** glabrous, without adventitious roots. **Leaves** glabrous; petiole 5–10 cm; blade 8–13.5 × 4.5–9 cm, ovate, unlobed, basally cordate to truncate, apically acuminate, often with small dark dots on the lower surface, the midvein abaxially flattened (and especially at the base, slightly overhanging the blade surface), with 7–9 secondary veins per side, the tertiary veins adaxially impressed. **Inflorescences** of 1–20 flowers; peduncle 1–2 cm, terete; bracts 10–20 × 5–10 mm, elliptic, minutely pustulose, ± persistent. **Flowers** subsessile or with the pedicel 1–5 mm; **sepals** subequal, 11–16 × 5–10 mm, oblong-elliptic, apically obtuse and mucronate (the mucro 1–2 mm), abaxially and minutely pustulose, adaxially and minutely strigulose, the margin somewhat lighter in a narrow, subhyaline band; **corolla** white with yellowish interpetalae, 50–70 mm, funnelform, externally glabrous; **stamens** with 2 filaments 27–34 mm and 3 filaments 18–22 mm, the basal 5–6 mm of filaments villous, the anthers 4–6 mm, oblong, sagittate, the pollen spheroidal, spinulose; **ovary** 2–3 mm, glabrous, the style 34–40 mm, glabrous (the basal 3–5 mm thickened and appearing rostrate on the ovary), the stigma biglobose. **Fruits** white, 1.1–1.2 × 0.9–1 cm, subglobose, glabrous, usually with the lower, thickened part of the style persistent; seeds dark brown, 6–7 × ca. 4 mm (not including trichomes), ovoid, ± trigonous, lanate around the margin with silvery golden to copper-colored trichomes to 10 mm.

Flowering Aug, Nov. Climbing on low shrubs and trees at edge of moist forest, 500–960 m; Costa Rica (Guanacaste), northern Pacific slope, northern Nicoya Peninsula, Cerro Brujo.

Additional collections examined. **COSTA RICA. Guanacaste.** Cantón and Dist. Santa Cruz. Dist. Santa Cruz. Peninsula de Nicoya. Parque Nacional Diría: Fila Vista del Mar. Camino a las Torres de Telecomunicaciones, 25 Aug 1995, *J. González et al.* 940 (INB); Rumbó a Cerro Brujo y Vista al Mar, 15 Nov 2008, *B. Hammel & I. Pérez* 24989 (CR, INB, MO); Cerca a la cima de Cerro Brujo, bajando rumbo a Vista al Mar, 16 Nov 2008, *B. Hammel & I. Pérez* 25026 (CR, INB, MO).

**Etymology.** The epithet is a combined toponym and descriptive: "diría" for the national park, near or in which the species has been found and "dactylina" meaning "divided into fingerlike structures" (Stern, 1983), in reference to its unusual fruiting calyx.

In the Convolvulaceae treatment (Hammel, 2010) for the *Manual de Plantas de Costa Rica* *Ipomoea diriadactylina* was treated as *I. "sp. A"* and keyed out next to *I. lindeni*. It can be confused with that locally sympatric species by the latter's similarly short-peduncled inflorescences with the pedicels sometimes as short, by its flowers with sepals of similar size and shape, and by the often white corolla with a similar shape. *Ipomoea lindeni*, however, is immediately distinguishable by having smaller, narrowly lanceolate and soon-caducous bracts, usually lanceolate and more distinctly hyaline-margined, non mucronate sepals, and seeds that are lanate with white trichomes and not only along the margin but also (at least puberulent) on the rest of the body. Even vegetatively these two species can be distinguished easily since *I. lindeni* is only rarely glabrous and often manifestly tomentose, its leaves are without black dots, and the midrib is abaxially and distinctly convex (vs. flattened). By these vegetative characters as well as by the seeds, the present species is much more easily confused with — virtually identical to — *I. batatoides* Choisy, which also is locally sympatric. One suspects that *I. diriadactylina* may be more closely related to *I. batatoides* and its near relatives. This latter species has much more open, virtually ebracteate inflorescences, and the flowers have much smaller, often suborbicular, non-mucronate sepals, usually with a pink (occasionally white)

corolla. The sepals of *I. diradactylina* also appear to be unique for their indument, minutely pustulose on the outer surface, minutely strigulose on (at least the upper 1/2 of) the inner. As per its characters and comparison to similar species, this new species would certainly be classified by Austin and Huáman (1996) in subgenus *Eriosperrum*, perhaps even of that same section and series, [Er,Er,Er] in their annotation.

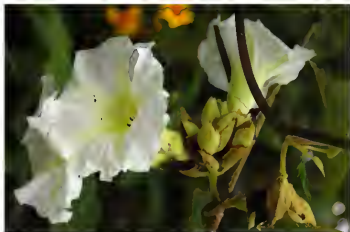


Figure 2. *Ipomoea diradactylina*. Photo by the author with flowers, from the type.

The first material of *Ipomoea diradactylina* was collected (with just one open flower) in 1995 by former INB curator José González. Not until several years later during preparation of the Convolvulaceae for the *Manual* did the problematic nature of this entity become apparent. In spite of several intervening searches, fertile plants were not found again until 2008 (in fruit) and 2009 (in flower and fruit). Apparently the species is not very common.

Although many trees in the area are thickly covered with large vines that resemble the new species, a reliable way has not been found to distinguish it vegetatively from *Ipomoea batatasoides*, which also grows in the area. The González specimen and two of the Hammel and Pérez gatherings are,



Figure 3. *Ipomoea diradactylina*. Photo by the author with fruits, from the type.

by their geographic coordinates, from virtually the same spot, perhaps even the same plant. Thus, only two different individuals are known for certain. Although it seems highly likely that *I. diriadactylina* is more common than collections indicate, the evidence is lacking. Records show that at least seven different botanists have collected in the area during the last 15 years, gathering only about 500 numbers and just over 300 species (from above 300 m). *Ipomoea diriadactylina* was found serendipitously only once out of those 500 numbers, the other three gatherings were the result of a concentrated effort by the author.



Figure 4. Type locality of *Ipomoea diriadactylina*. Photo by the author from south side of Cerro Brujo looking south towards Cerros Mata de Caña and Vista al Mar

The ridge from where the new species has been collected comprises, in part, a close North to South series of three hills (named on maps) above 900 meters: Cerro Brujo (ca. 960 m), Cerro Mata de Caña (972 m), and Cerro Vista al Mar (Cenizosa, 983 m). Only one other peak, Cerro Azul, ca. 45 km southwest, is slightly higher, at 1018 m, on the generally low-lying Nicoya Peninsula. At least part of this ridge is in, or borders on, the recently declared National Park of Diria and has been the site of numerous recent country records for Costa Rica, including *Anisacanthus nicaraguenis* Durkee, *Chileroanthemum pyramdatum* (Lindau) T.F. Daniel (Acanthaceae), *Doyerea emetocathartica* Grosourdy (Cucurbitaceae), *Ipomoea suaveolens* (M. Martens & Galeotti) Hemsl., *Schwenckia lateriflora* (Vahl) Carvalh. (Solanaceae), and *Tridax platyphylla* B.L. Rob. (Asteraceae). As continued exploration (and work on previously collected material) in this area ensues, more new species and country records are sure to follow.

#### ACKNOWLEDGMENTS

I thank Isabel Pérez (INB) for her help in the field on all trips to the Parque Nacional Diria, as well as for reviewing the Spanish abstract. I am also grateful to park administrator Ademar Rosales for facilitating our numerous visits to P.N. Diria. Freelance illustrator Claudia Aragon provided the fine black-and-white illustration. Thanks also to Michael Grayum (MO) for helpful discussions concerning this manuscript and especially for help in zeroing in on an appropriate epithet, I take full

blame, however, for its final form. Special thanks to Dan Austin (ASDM) for his, as always, prompt and helpful comments on the manuscript.

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## ADIVULGATION OF IGNORED OR FORGOTTEN BINOMIALS

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### ABSTRACT

A review of two works published in 1874 and 1875 (Gardeners' Chronicle and Revue Horticole) lead to a number of names (mainly binomials) for vascular plants (861) not reported in the International Plant Nomenclature Index (461) or for which an earlier place of publication was found for the same name (400). Given the results from this small sampling, and because more of the horticultural literature is becoming available online, a major effort should be made to review these long ignored works for their scientific plant names. Four new generic names (*Acanthorrhiza*, *Brassica-napus*, *Eremospatha*, and *Polyanthus*) were noted along with one name at the rank of tribe (*Adenostyleae*). One species, *Jonquilla odora* Raf. (1838), and one genus, *Phylogyne* Salisb. ex Haw. (1819), are lectotypified.

**KEY WORDS:** nomenclature, horticultural literature, online nomenclatural resources, International Plant Name Index (IPNI), Gardeners' Chronicle, Revue Horticole

Modern-day vascular plant taxonomists are dependent upon the International Plant Name Index database (IPNI — <http://www.ipni.org/ipni/>) that has replaced the printed versions known commonly at the Kew Index and Gray Gard Index. While other databases such as TROPICOS (<http://www.tropicos.org/>) and the recently introduced Plant List (<http://www.theplantlist.org/>) are useful, IPNI is still the most authoritative. These works have tended, properly, to concentrate upon the established systematic literature and therefore have tended to ignore such works as scientific dictionaries, general interest encyclopedias, and textbooks even though these publications often contain taxonomic novelties. A survey of the horticultural literature (e.g., weekly or monthly newspapers, seed catalogues, horticultural proceedings or journals, gardening or agriculture books) has been more thorough, but emphasis, at least in IPNI, has been to specific articles by select individuals — possibly a result of the once prevalent “Kew Rule” for botanical names (i.e., nomenclature used by an established monographer or in a major publication should be adopted, or “priority within a genus was reckoned from the date when a specific epithet was first associated with that generic name” — see IPNI 2012; Jackson 1887; Nicolson 1991). What has been overlooked have been the more general articles, letters, reports of meetings, results of horticultural shows and events, and especially the advertisements that frequent such weekly publications as the Gardeners' Chronicle or The Garden. Even less attention has been paid to local garden or farm newspapers, and less still to gardening columns in rural newspapers.

The information presented here is the result of a simple experiment at the Liberty Hyde Bailey Hortorium to ascertain what could be learned about the names listed in *Hortus Third* (1976) as names of no taxonomic standing. It did not take long to realize that many of these names were validly published and could be found by an online search. As more and more of the horticultural holdings at Harvard University (including Arnold Arboretum), Cornell University, and other institutions became available online, it was soon obvious that to understand the extent of the nomenclatural problem required a detailed review using only a small subset of the potential literature where vascular plant names might be found. Accordingly, two works were selected that were available online, and then names or references found therein were followed in search (hopefully) of



the first place of publication of a name. If another work was then suggested in a subsequent source, then that too was consulted for that name or names, and so forth.

Two years (1874–1875) of the weekly newspaper *Gardeners' Chronicle* and the monthly publication *Revue Horticole* were selected as both were readily available in the Hortorium Library and online. Literally each page of each publication was reviewed for names. This included not only the articles, but the letters and reports on garden shows and events wherein plants were named and often described, albeit briefly, usually because such new species typically were on public display for the first time and received awards or certificates of recognition. It soon became obvious that the other weekly British newspaper, *The Garden*, also had to be consulted (although less intensely) as often the same garden show was reviewed in both papers, and thus some names have priority in one place by a week although in a few cases the same name was validated in both newspapers on the same date.

A critical source of names was found to be the advertisements. Here one would often find a detailed diagnosis or description of a new species. Such ads then meant one had to look at the company's catalogue. This, then, often required a search of newspapers to determine exactly when the catalogue was published. It was not unusual to find one or the other was published a few days apart based on announcements of the availability of a new catalogue from a particular company. This kind of work can only be done at an institution like the Bailey Hortorium because of the readily available resources at Cornell University.

On 6 October 2011, a listing of some 4600 names not listed or not correctly listed in IPNI was submitted to IPNI (both at Harvard University and the Royal Botanic Garden at Kew), with copies of the report sent to the International Association for Plant Taxonomy (IAPT) and the New York Botanical Garden. The vast majority of names were at the rank of variety — names traditionally ignored by IPNI (except for New World plants) until 1970 (IPNI 2012). Nonetheless, of that number, some 855 names were binomials, and of those only three names proved to have a possible nomenclatural impact that will require formal proposals to conserve or reject a name. What taxonomic problems might result from the findings presented here are unknown as this requires the expertise of monographers and a review of extant type material. In many instances, the binomials reported here are associated with original material, especially at Kew (K), so that additional nomenclatural work dealing with the designation of lectotypes will be necessary.

An obvious question is “why bother?” After all, the scientific world has existed happily without making a specific effort to look seriously for names in the horticultural literature. Still, it is obvious that by consulting just the two years of the *Gardeners' Chronicle* one does find several new names, especially orchids described by Heinrich Gustav Reichenbach (1824–1889), that were described therein and are listed in the IPNI database. Likewise, some genera and families have been carefully reviewed by past workers, and again many names first proposed in the *Chronicle* are already in IPNI although not always dating from the earliest place of publication. What is much more common is that a name in IPNI is taken from a traditional taxonomic work, or from a work published by a well-known author, even though the very same name was first validly proposed originally in the horticultural literature. Finally, and this is the most critical fact, such names can now be found easily as more of the horticultural literature is made available, online, in a searchable form. Researcher can no longer pretend that the traditional horticultural literature no longer exists, and when the early seed catalogues are made available, as they will be in the future, the problem will only become more exasperating.

The purpose of this report to the broad botanical community is to suggest that now is the time to review the horticultural literature in a more consistent manner than done in the past. Either the *Code* must be altered to disallow names published in the horticultural literature, or we must in some

way to evoke a new “Kew Rule” so that we can ignore certain categories of names as seemingly we are presently.

The following listing is divided into three parts: (a) names not currently in IPNI; (b) names published earlier than given in IPNI; and (c) names arranged by families. Each name is associated with a full bibliography entry and a statement of how the name was validated. When the diagnosis or description is brief, or dubious, the actual wording is given. Such brief remarks must be evaluated in context of what was known at the time about the genus or species complex, and with closer study it is likely that some names listed here will be interpreted as invalid. Combinations can sometimes be affected by provisions in Art. 33.3 (McNeill et al., 2006), although more often the reference is merely indirect. Minor differences in spelling are noted for it might be argued that some names are orthographic variant rather than new entities. Questionable cases are noted. Names that are not legitimate when published are also noted — most are later homonyms. A family name (APG 2009; Christenhusz 2011a, b) is given for each name followed by an occasional note. A few additional names not related to the horticultural literature are also noted (e.g., *Arctostaphylos intermedia* Greene ex Howell; *Persicaria alata* (Buch.-Ham. ex D.Don) Nakai).

## NAMES NOT CURRENTLY IN IPNI

- Abies brachyptera* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874. Validated by a description in French. – Pinaceae.
- Abies dicksonii* C. van Geert ex K.Koch, Wochensch. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 119. 11 Apr 1863. Validated by a diagnosis in German. – Pinaceae.
- Abutilon savitzi* André, Rev. Hort. 67: 249. 1 Jun 1895. Validated by a description. – Malvaceae.
- Acacia oleifolia* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 111. 1834, *nom. illeg.*, as “*oleaeifolia*”, non A. Cunn. ex G. Don (1832). Validated by a brief description in Italian. – Fabaceae.
- Acacia scandens* (L.) Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 117. 1834, *nom. illeg.*, non Willd. (1806) nec Willd. (1809), *nom. illeg.*, based on *Mimosa scandens* L., Sp. Pl., ed. 2: 1501. Jul-Aug 1763. – Fabaceae.
- Acacia spini* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 123. 1834. Validated by a description in Italian. – Fabaceae.
- Acantholimon spinosum* Rob., Gard. Chron., ser. 3, 96: 31. 14 Jul 1934. Validated by a description in English. – Plumbaginaceae.
- Acer flavescens* Veitch, Garden (London) 5: 364. 25 Apr 1874. Validated by a diagnosis in English. – Sapindaceae.
- Acnida rhyssocarpa* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 384. 1834, *nom. illeg.*, as new name for *A. ruscocarpa* Michx., Fl. Bor.-Amer. 2: 234, t. 40. 19 Mar 1803. – Amaranthaceae.
- Adenanthera ossea* Mannetti in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 141. 1834, *nom. illeg.* Validated by a description in Italian. – Fabaceae. NOTE: The name is not legitimate as the author cited “*Clypearia rubra*” Rumphius, Amb. 3: 176, t. 112. 1743, the type of *Inga clypearia* Jack. (1822).
- Adenophora farreri* S. Arnott, Gard. Chron., ser. 3, 86: 183. 7 Sep 1929. Validated by a description in English. – Campanulaceae.
- Adenostyleae* Cass. in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 14. 1834 (*Adenostyleae*). Validated by a description in Italian. – T.: *Adenostyles* Cass. (1816). – Asteraceae.
- Adiantum jarlegense* C.Loury, Rev. Hort. 47: unpag. 16 Jul 1875. Validated by description in French. – Adiantaceae.
- Adiantum zahnii* Veitch, Florist & Pomol. 27: 158. Jul 1874. Validated by a description in English. – Adiantaceae.
- Aethionema purpureum* F.G.Sealey, Gard. Chron. 36: 73. 1932. Validated by a brief description in English (“A dwarf evergreen shrublet with many purple flowers”). – Brassicaceae.

- Agave killisheea* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a brief description in French ("feuilles longues vert clair avec une bande jaune au centre"). – Asparagaceae.
- Agave leopoldti* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a description in French. – Asparagaceae.
- Agave monstrosa* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a brief description in French ("feuilles épaisses, vert foncé, largement bordées de blanc"). – Asparagaceae.
- Agave mooreana* Mast. & T.Moore, Gard. Chron., n. s., 1: 60. 10 Jan 1874. Validated by a diagnosis in English. – Asparagaceae.
- Agave perringeae* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a brief description in French ("Feuilles courtes, vert terne, bordées de blanc"). – Asparagaceae.
- Agave robusta* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a brief description in French ("feuilles vert clair, bordées de blanc"). – Asparagaceae.
- Agnus-castus alba* Carrière, Rev. Hort. 46: 400. 16 Oct 1874. Validated by a description in French. – Lamiaceae.
- Agnus-castus marostachya* Carrière, Rev. Hort. 46: 400. 16 Oct 1874. Validated by a description in French. – Lamiaceae.
- Aiþhanes bicuspidata* (H.Karst.) Ed.Otto, Hamburger Garten-Blumenzeitung 31: 24. Jan 1875, based on *Marara bicuspidata* H.Karst., Linnæa 28: 390. Jun 1857. – Arecaceae.
- Alloplectis bicolor* Linden, Cat. Pl. Exot. 22/23: 1. Jan-Jun 1869, *nom. illeg.*, non G.Don (1855). Validated by a description in French. – Gesneriaceae.
- Alocasia chantriieri* (Andre) Duch. (pro hybr.), J. Soc. Nat. Hort. France, ser. 3, 9: 704. 24 Nov 1887. Validated by a description in French. – Araceae.
- Alocasia* × *hybrida* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 17. 1 Apr 1871 (*A. lowii* × *A. metallica*). Validated by a description in English. – Araceae.
- Alocasia* × *intermedia* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 2. Aug 1868 (*A. longiloba* × *A. verticillif.*). Validated by a diagnosis in German. – Araceae.
- Aloe fraskii* Croucher, J. Hort. Cottage Gard. 27: 163. 20 Aug 1874. Validated by a brief diagnosis in English ("the base of the leaves clasping the stem like a cup"). – Xanthorrhoeaceae. NOTE: See also Garden 6: 188. 22 Aug 1874. Validated by a brief diagnosis in English ("thick amplexicaule leaves").
- Aloe macchiata* Da Pare in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 4: 547. 1835. Validated by a diagnosis in Italian. – Xanthorrhoeaceae. NOTE: The name could also be considered a new name for *A. maculata* Ker. Gawl., Bot. Mag. 20: ad t. 765. 1804, non Forssk. (1775) or *A. obliqua* Haw., Trans. Linn. Soc. London 7: 14. 1804, *nom. illeg.*, non DC. (1802).
- Aloe quadrangularis* Da Pare in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 4: 546. 1835, *nom. illeg.*, non Dum. Cours. (1811). Validated by a description in Italian. – Xanthorrhoeaceae.
- Amaranthus chlororuber* Haage & Schmidt, Haupt-Verz. Samen 1875: 6. Jan 1875, as "chloro-ruber." Validated by a diagnosis in German. – Amaranthaceae.
- Amaranthus* × *henderi* Hurst, Gard. Chron., n.s., 2: 738. 12 Dec 1874. Validated by description in English. – NOTE: Name given as "Hybrid Amaranthus henderi." – Amaranthaceae.
- Amaranthus henderi* W.Hend., Gard. Chron., n.s., 2: 770. 19 Dec 1874, *nom. illeg.*, non Hurst. (1874). Validated by description in English. – Amaranthaceae.
- Amaranthus hendersonii* J.Weber, J. Hort. Cottage Gard. 27: 304. 1 Oct 1874. Validated by a description in English. – Amaranthaceae.
- Amaranthus hendersonii* Hort., Vick's Ill. Mag. 1: 354. Dec 1878, *nom. illeg.*, as "hendersoni" Validated by a description in English. – Amaranthaceae.
- Amaranthus salignus* Carrière, Rev. Hort. 46: 80. 16 Feb 1874. Validated by a poorly organized description in French. – Amaranthaceae.
- Amaryllis hybrida* Neubert, Deutsch. Mag. 32: 333. 1879. Validated by a diagnosis in German. – Amaryllidaceae.

- Amaryllis* × *mooreana* B.S.Williams, Garden (London) 5: 364. 25 Apr 1874. Validated by a diagnosis in English. – Amaryllidaceae.
- Amaryllis virginalis* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874. Validated by a description in English. – Amaryllidaceae.
- Andromeda forrestii* (Harrow ex W.W.Sm.) C.K.Schneid. in Gartenbau im Reich 11: 209. 1930, based on *Pieris forrestii* Harrow ex W.W.Sm. in Notes Roy. Bot. Gard. Edinburgh 8: 196. 1914. – Ericaceae.
- Anemia plumbea* Makoy ex E.Morren, Belg. Hort. 25: 200. 1875. Validated by a description in French. – Anemiaceae.
- Anemia tessellata* Makoy ex E.Morren, Belg. Hort. 25: 200. 1875. Validated by a description in French. – Anemiaceae.
- Anoetochilus lobbi* B.S.Williams, Orch. Grow. Man., ed. 2, 49. Oct 1862. Validated by a description in English. – Orchidaceae.
- Anoetochilus maculatus* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862. Validated by a description in English. – Orchidaceae.
- Anoetochilus querceticochus* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862. Validated by a description in English. – Orchidaceae.
- Anoetochilus veitchii* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862. Validated by a description in English. – Orchidaceae. NOTE: As there is an earlier *A. veitchianus* Blume (Coll. Orchid. 119. 1859), it is possible the Williams name is an orthographic variant.
- Anthurum crystallinum* Th.Meehan, Gard. Chron., n.s., 1: 92. 17 Jan 1874. Validated by a description in English. – Asparagaceae.
- Anthyllis spinosa* Franceschi in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 4: 901, 902. 1835. Validated by a diagnosis in Italian. – Fabaceae.
- Antirrhinum muridicum* Haage & Schmidt, Haupt-Verz. Samen 1875: 67. Jan 1875. Validated by a description in German. – Plantaginaceae.
- Aquilegia caryophyllodes* S.Hibberd in Floral World Gard. Guide: 142. Jul 1860. Validated by a brief diagnosis in Latin (“double white-striped”). – Ranunculaceae. NOTE: A later place of publication: *Aquilegia caryophyllodes* G. Abbey in J. Hort. Cottage Gard. 32: 457. 21 Jun 1877. Validated by a brief description in English (“striped and mottled flowers”).
- Aralia granatensis* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Araliaceae.
- Araucaria neocaledonica* Linden ex Regel, Gartenflora 24: 176. 15 Jun 1875. Validated by a diagnosis in German. – Araucariaceae.
- Arctostaphylos intermedia* Greene ex Howell, Fl. N.W. Amer. 1: 415. 1901, *nom. illeg.* – Ericaceae. The name is a superfluous renaming of *A. media* Greene in *Pittonia* 2: 171. Sep 1891.
- Areca dealbata* W.Bull., Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863. Validated by a description in English. – Arecaceae.
- Aristolochia elevata* Gera, Nuovo Diz. Univ. Agric. 5: 348. 1837. Validated by a description in Italian. – Aristolochiaceae.
- Armeliaca alexandrina* Gera, Nouv. Diz. Univ. Ragion. Agric. 3: 337. 1835. Validated by a description in Latin. – Rosaceae.
- Armeria echioides* Dennst., Hort. Belveder. 1: 95. 1820, *nom. illeg.*, a new name for *Statice denticulata* Bertol., Rar. Ital. Pl. Dec. 2: 34. 1806. – Plumbaginaceae.
- Armeria lauchiana* Haage & Schmidt, Pl.-Verzeichn. 2. Jan 1875. Validated by a description in German. – Plumbaginaceae.
- Artocarpus neo-caledonica* Linden ex Cazzuola & Nencioni, Coltiv. Piant. Orn., ed. 2, 222. 1889. Validated by a diagnosis in Italian. – Moraceae. NOTE: Only the second edition seen and the first edition should be checked.
- Astelia bivittata* Watson, Proc. Roy. Hort. Soc. 46: 159. Oct 1864. Validated by a description in English. – Asteliaceae.

- Aster rubicaulis* Gera, Nuovo Diz. Univ. Agric. 6: 494. 1837. Validated by a description in Italian. Introduced from "America settentrionale [sic]". – Asteraceae.
- Astilbe sinensis* C.Pfeiff., Gartenwelt 3: 512. 23 Jul 1899. Validated by a diagnosis in German. – Saxifragaceae. NOTE: Possibly an orthographic variant of *Astilbe chinensis* Franch. & Sav., Enum Pl. Jap. 1: 144. 1873.
- Atragene ceilanica* (Thurb.) Gera, Nuovo Diz. Univ. Agric. 6: 507. 1837, based on *Fagraea ceilanica* Thunb., Kongl. Vetensk. Acad. Nya Handl. 1782: 132. 1782. Also associated with a description in Italian. – Ranunculaceae based on generic name; Loganiaceae based on epithet. NOTE: This is almost certainly an error, and the intended name was *A. clematides* Crantz (1769).
- Aubrieta hendersonii* E.G.Hend., Gard. Chron., n.s., 1: 2. 3 Jan 1874, as "*Aubrieta hendersoni*." Validated by a description in English. – Brassicaceae.
- Aucuba vivicans* W.Bull, Gard. Chron., n.s., 3: 619. 15 May 1875. Validated by a description in English. – Garryaceae.
- Azalea* × *todmanti* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873 (*Azalea* Duchess Adelaide von Nassau × *A. stella*). Validated by a diagnosis in English. – Ericaceae.
- Batemannia burtii* W.B.Hume, Florist & Pomol. 27: 60. Mar 1874. Validated by a description in English. – Orchidaceae.
- Beaucarnea tuberculata* (Hort. ex Lem.) Hurst, Gard. Chron., n.s., 2: 738. 12 Dec 1874, based on *Pincenectitia tuberculata* Hort. ex Lem., Ill. Hort. 8: 48, 59, 61. 1861. – Asparagaceae.
- Begonia* × *valida* P.W.Burbidge, Cultivated Pl. 202. 1877 (*B. longipila* × *B. boliviensis*). Validated by a description in English. – Begoniaceae.
- Berberis cordiformis* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Berberidaceae.
- Bertolonia pubescens* G.W.Johns. & R.Hogg, J. Hort. Cottage Gard, n.s., 8: 397. 23 Mai 1865. Validated by a brief description in English. – Melastomataceae.
- Bertolonia punctata* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 3. 1 Apr 1871. Validated by a diagnosis in English. – Melastomataceae.
- Bertolonia* × *vanhouttei* T.Moore, Florist & Pomol. 28: 143. Jun 1875. Validated by a diagnosis in English. – Melastomataceae.
- Betula purpurea* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Betulaceae.
- Bignonia roezliana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 4. 1 Apr 1871. Validated by a description in English. – Bignoniaceae.
- Billbergia musaica* (Linden & André) Regel, Gartenflora 23: 378. Dec 1874, based on *Tillandsia musaica* Linden & André, Ill. Hort. 20: 171. 1873. – Bromeliaceae.
- Boltonia laevigata* E.Witte, Ned. Tuinbouwbl. Sempervirens 1: 419. 10 Oct 1903. Validated by a description in Dutch. – Asteraceae.
- Brassica-napus* Vilm., Bon Jard. 348. 1837. Validated by a diagnosis in French. – T.: *B. sylvestris* Vilm. – Brassicaceae.
- Brassica-napus sylvestris* Vilm., Bon Jard. 348. 1837. Validated by a diagnosis in French. – Brassicaceae. NOTE: Under the provisions of Art. 33.3, one might argue that the combination is based on *Brassica sylvestris* Mill. (1768) although that name is not mentioned.
- Burlingtonia amoena* B.S.Williams, Orch. Grow. Man., ed. 2, 62. Oct 1862. Validated by a description in English. – Orchidaceae.
- Calceolaria discolor* Herb., Amaryllidaceae 363. late Apr 1837. Validated by a diagnosis in English. – Calceolariaceae.
- Calochortus krelagei* (Regel) Ortgies, Gartenflora 23: 49. Jan 1874, based on *C. gunnisonii* var. *krelagei* Regel, Gartenflora 22: 213. 1873. – Liliaceae.
- Caltha grandiflora* (Robert) Rob., Garden (London) 6: 47. 18 Jul 1874, based on *Ficaria grandiflora* Robert, Pl. Phan. Toulon 57, 112. 1838. – Ranunculaceae.

- Camellia fimbriata* P.B.M., Young Churchman Misc. 3: 47. Feb 1848. Validated by a description in English. – Theaceae.
- Camellia incarnata* P.B.M., Young Churchman Misc. 3: 47. Feb 1848. Validated by a description in English. – Theaceae.
- Carladovica jonghei* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875. Validated by a diagnosis in German. – Cyclanthaceae.
- Caryota tenuis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Caryota verschaffeltii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Catalpa × aureovittata* Carrière, Rev. Hort. 46: 140. 1 Apr 1874 (*C. syringifolia* × *C. bungei*). Validated by a description in French. – Bignoniaceae.
- Cattleya lutea* Guidon, J. Soc. Cent. Hort. France 4: 250. Apr 1858. Validated by a description in French. – Orchidaceae.
- Cattleya mcmorlandii* B.S. Williams, Orch. Grow. Man., ed. 2, 74. Oct 1862. Validated by a description in English. – Orchidaceae.
- Ceropegia macrocarpa* Haage & Schmidt, Pfl.-Cat. 1874: 2. Jan 1874. Validated by a diagnosis in German. – Apocynaceae.
- Cephalotaxus robusta* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874. Validated by a description in French. – Cephalotaceae.
- Chamaedorea ahrenbergii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 113. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaeranthemum reticulatum* W.Bull, Proc. Roy. Hort. Soc. 4: 73. Apr 1864. Validated by a diagnosis in English. – Acanthaceae.
- Chamaerops arborea* Linden, Suppl. Extrait Cat. Gén. 82/24: 26. 1 Jul 1869. Validated by a diagnosis in French. – Arecaceae.
- Chamaerops major* Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaerops nivea* Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaerops tenuifrons* Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Cheiranthus dillenianus* R.Dean, Florist & Gard. 28: 188. Aug 1875. Validated by a brief description in English (“coppery-bluff flowers, and a rather straggling and weakly habit of growth”). – Brassicaceae.
- Chironia tixifera* W.Bull, Gard. Chron., n.s., 2: 294. 5 Sep 1874. Validated by a description in English. – Gentianaceae.
- Chrysophyllum lancifolium* Linden, Cat. Pl. Exot. 22/23: 25. Jan-Jun 1869. Validated by a diagnosis in French. – Sapotaceae.
- Cibothum spectabile* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 2. Aug 1868. Validated by a diagnosis in German. – Cibiaceae.
- Clarkia integripetala* S.O.Johnson, Rural Affairs 6: 198, fig. 108. 1877. Validated by a description in English. – Onagraceae.
- Clematis atropurpurea* Spae ex T.Moore & Jackman, Clematis 82. Sep-Dec 1872. Validated by description in English. – Ranunculaceae. NOTE: Moore and Jackman cited Ill. Hort. 7: ad t. 254. 1860 where the name *C. patens* var. *atropurpurea* is a nom. nud.
- Clematis × aureliana* Briolay-Goiffon ex T.Moore & Jackman, Clematis 83. Sep-Dec 1872 (*C. lanuginosa* × *C. patens*), as “*aureliana*.” Validated by a description in English. – Ranunculaceae.
- Clematis calypso* Lemoine ex T.Moore & Jackman, Clematis 86. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.

- Clematis crispis* R.D., Florist & Pomol. 3: 214. Sep 1870. Validated by a description in English. – Ranunculaceae.
- Clematis* × *fulgens* Simon-Louis ex T.Moore & Jackman, Clematis 100. Sep-Dec 1872 (*C. lanuginosa* × *C. viticella* var. *grandiflora*). Validated by a description in English. – Ranunculaceae.
- Clematis imperialis* Carré ex T.Moore & Jackman, Clematis 107. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis insignis* T.Moore & Jackman, Clematis 107. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis magnifica* T.Moore, Fl. Mag.; ad t. 8: 453. 1869. Validated by a description in English. – Ranunculaceae.
- Clematis marmorata* Jackman ex T.Moore & Jackman, Clematis 125. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis* × *modesta* Modeste-Guérin ex T.Moore & Jackman, Clematis 127. Sep-Dec 1872 (*C. lanuginosa* × *C. viticella*). Validated by a description in English. – Ranunculaceae.
- Clematis ornata* Lemoine ex T.Moore & Jackman, Clematis 132. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis perfecta* Simon-Louis ex T.Moore & Jackman, Clematis 134. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis picturata* Jackman Gard. Chron., n.s., 3: 790. 19 Jun 1875. Validated by a description in English. – Ranunculaceae.
- Clematis plena* V.A.Gressent, Class. Jard. 245. 1880. Validated by a brief description in French. – Ranunculaceae.
- Clematis pulcherrima* Cripps ex T.Moore & Jackman, Clematis 136. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis purpurea* V.A.Gressent, Class. Jard. 245. 1880. Validated by a brief description in French. – Ranunculaceae.
- Clematis reginae* A.Henry, Mag. Hort. Bot., ser. 4, 29: 153. Apr 1862. Validated by a description in English. – Ranunculaceae.
- Clematis rendatleri* Carré ex T.Moore & Jackman, Clematis 138. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis* × *symesiana* Anderson-Henry ex T.Moore & Jackman, Clematis 145. Sep-Dec 1872 (*C. lanuginosa* × *C. fortunei*). Validated by a description in English. – Ranunculaceae.
- Clematis vanhouttei* Jackman ex T.Moore & Jackman, Clematis 149. Sep-Dec 1872, as “*Van Houttei*.” Validated by a description in English. – Ranunculaceae.
- Clematis verschaffeltii* Carré ex T.Moore & Jackman, Clematis 149. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis vesta* Jackman ex T.Moore & Jackman, Clematis 150. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis* × *viticello-lanuginosa* E.Morren, Beliq. Hort. 14: ad t. 18. 1864, *nom. illeg.*, a new name for *C. × intermedia* Bonamy ex T.Moore & Jackman, Clematis 107. Sep-Dec 1872, see above. – Ranunculaceae.
- Clematis* × *willsonii* Hort., Gard. Chron., n.s., 4: 17. 3 Jul 1875 (parentage not given). Validated by a description in English. – Ranunculaceae.
- Clerodendrum balfourianum* Hort., Gard. Chron., n.s., 3: 667. 22 Mai 1877. Validated by a brief description in English (“...white calyces and crimson corollas...”). – Lamiaceae.
- Codiaeum angustifolium* Hort., Gard. Chron., n.s., 1: 664. 23 May 1874. Validated by a description in English (“long, slender drooping foliage”). – Euphorbiaceae.
- Coelanthus amplifolius* Willd. ex Herb., Amaryllidaceae 86. late Apr 1837. Validated by a description in English. – Asparagaceae. NOTE: Herbert took his name from an herbarium

- specimen. If this is the same collection Schultes used to establish *C. complicates* Willd. ex Schult.f., then the Herbert name is not legitimate.
- Coelogyne lowii* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862. Validated by a description in English. – Orchidaceae.
- Coelogyne meadia* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862. Validated by a description in English. – Orchidaceae.
- Coleus* × *batemannii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. gibsonii*), as “*Batemanni*.” Validated by a description in English. – Lamiaceae.
- Coleus* × *bausei* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. veitchii*). Validated by a description in English. – Lamiaceae.
- Coleus* × *berkeleyi* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868 (*C. verschaffetii* × *C. veitchii*). Validated by a description in English. – Lamiaceae.
- Coleus* × *clarkii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. gibsonii*). Validated by a description in English. – Lamiaceae.
- Coleus* × *dixii* H. T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868 (*C. verschaffetii* × *C. veitchii*). Validated by a description in English. – Lamiaceae.
- Coleus marmoratus* W.Bull, Proc. Roy. Hort. Soc. 4:133. Jul 1864. Validated by a description in English. – Lamiaceae.
- Coleus* × *murrayi* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. gibsonii*). Validated by a diagnosis in English. – Lamiaceae.
- Coleus* × *reveeii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. blumei*), as “*Reveesi*.” Validated by a description in English. – Lamiaceae.
- Coleus* × *ruckeri* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868 (*C. verschaffetii* × *C. gibsonii*). Validated by a description in English. – Lamiaceae.
- Coleus* × *saundersii* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868 (*C. verschaffetii* × *C. veitchii*). Validated by a description in English. – Lamiaceae.
- Coleus* × *scottii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868 (*C. verschaffetii* × *C. gibsonii*), as “*Scotti*.” Validated by a description in English. – Lamiaceae.
- Coleus telfordii* McPhail ex H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 3. Aug 1868 (*C. verschaffetii* × *C. veitchii*), as “*Telfordi*.” Validated by a description in German. – Lamiaceae.
- Cordylone kirkii* Haage & Schmidt, Haupt-Verz. Samen 1875: 4. Jan 1875. Validated by a diagnosis in German. – Asparagaceae.
- Corypha robusta* Wendl. ex Devansaye, Rev. Hort. 47: 32. 16 Jan 1875, *nom. illeg.*, based on *Saribus subglobosus* Hassk., Hov. & De Vries, Tijdschr. 9: 177. 1842. – Arecaceae.
- Crimm alboense* Herb., Amaryllidaceae 272. late Apr 1837. Validated by a diagnosis in Latin. – Amaryllidaceae.
- Crimm* × *gowenianum* Herb., Trans. Hort. Soc. London 3: 190-191, fig. Jan-Feb 1820 (*C. capense* × *C. zeylanicum*). Validated by a diagnosis in English. – Amaryllidaceae.
- Crimm* × *lousiae* Herb., Amaryllidaceae 274. late Apr 1837 (*C. speciosum* × *C. defixum*). Validated by a diagnosis in English. – Amaryllidaceae.
- Crocus napolitanus* Loisel., Herb. Gén. Amateur 2: ad t. 101. 1817, *nom. illeg.*, based on *C. vernus* Curtis, Bot. Mag. 2: ad t. 45. 1788. – Iridaceae.
- Croton aucubifolius* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869, as “*aucubaeifolium*.” Validated by a diagnosis in French. – Euphorbiaceae.
- Croton chrysophyllum* W.Bull. Gard. Chron., n.s., 3: 523. 24 Apr 1875. Validated by a description in English. – Euphorbiaceae.
- Croton cooperi* Hort., Gard. Chron., n.s., 1: 836. 27 Jun 1874, as “*cooperii*.” Validated by a description in English. – Euphorbiaceae.
- Croton disraelii* Veitch, Gard. Chron., n.s. 3: 473. 10 Apr 1875, as “*Disraeli*.” Validated by a description in English. – Euphorbiaceae.



- Croton fucatum* W.Bull, Retail List [Spec. List Gladiolus. 68:] 13. Sep-Oct 1872. Validated by a description in English. – Euphorbiaceae.
- Croton harwoodianum* Hort, Gard. Chron., n.s., 3: 602. 8 May 1875. Validated by a description in English. – Euphorbiaceae.
- Croton lacteum* Veitch, Cat. New Beautiful Pl. 1873: 37. Jul-Aug 1873. Validated by a description in English. – Euphorbiaceae.
- Croton limbatum* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Euphorbiaceae.
- Croton majesticum* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874. Validated by a description in English. – Euphorbiaceae.
- Croton maximus* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869, as “*maximum*.” Validated by a diagnosis in French. – Euphorbiaceae.
- Croton trilobum* W.Bull, Hamburger Garten-Blumenzeitung 31: 446. Oct 1875. Validated by a description in German. – Euphorbiaceae.
- Croton veitchii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 20. 1 Apr 1871. Validated by a diagnosis in English. – Euphorbiaceae.
- Croton volutum* Hort., Gard. Chron., n.s., 1: 690. 30 May 1874. Validated by a description in English that is quoted from Bull’s *Catalogue of New Plants*. – Euphorbiaceae.
- Croton youngii* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873. Validated by a description in English. – Euphorbiaceae.
- Cryptomeria lycopodioides* Carrière, Rev. Hort. 46: 220. 1 Jun 1874. Validated by a description in French. – Cupressaceae.
- Cyanophyllum bowmannii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871, as “*Bowmannii*.” Validated by a diagnosis in English. – Melastomataceae.
- Cyanophyllum marmoreum* Linden ex Ender, Gartenflora 24: 360. 1 Dec 1875. Validated by a diagnosis in German. – Melastomataceae.
- Cyanophyllum spectandum* Linden, Cat. Pl. Exot. 22/23: 4. Jan-Jun 1869. Validated by a diagnosis in French. – Melastomataceae.
- Cyathea microlepis* G., Garden (London) 5: 9. 3 Jan 1874. Validated by a description in English. – Cyatheaceae. NOTE: The identity of “G.” is unknown.
- Cycas ruminiana* W.Bull, Proc. Roy. Hort. Soc. 4:134. Jul 1864. Validated by a description in English. – Cycadaceae.
- Cyclobothra maweana* Tuberger, Wholesale Cat. Flowerroots 14. 1892. Validated by a diagnosis in English. – Liliaceae.
- Cypripedium bflora* B.S.Williams, Orch. Grow. Man., ed. 2, 85. Oct 1862. Validated by a description in English. – Orchidaceae.
- Cypripedium dayii* B.S.Williams, Orch. Grow. Man., ed. 2, 85. Oct 1862. Validated by a description in English. – Orchidaceae. NOTE: Possibly an orthographic variant of *C. dayanum* Rehb.f., Bot. Zeitung (Berlin) 20: 214. 1862.
- Cypripedium longifolium* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 61. 1 Apr 1871, *nom. illeg.*, non Rehb.f. & Warsz. Validated by a description in English. – Orchidaceae.
- Cypripedium × marshallianum* Rehb.f., Gard. Chron., n.s., 4: 804. 25 Dec 1875 (*C. concolor* × *C. paridimum*). Validated by a description in Latin. – Orchidaceae.
- Cypripedium pearcii* Veitch, Proc. Roy. Hort. Soc. 4:133. Jul 1864. Validated by a description in English. – Orchidaceae.
- Cypripedium × selligerum* Veitch, Gard. Chron., n.s., 3: 728. 5 Mai 1875 (*C. laevigatum* × *C. barbatum*). Parentage indicated but no description or diagnosis. – Orchidaceae.
- Daemonorops cinnamomeus* Schaedtler, Hamburger Garten-Blumenzeitung 31: 161. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Daemonorops ornatus* W.Bull, Gard. Chron., n.s., 3: 523. 24 Apr 1875. Validated by a brief description in English (“finely cut pinnate leaves”). – Arecaceae.

- Daemonorops oxleyanus* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 162. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Daphne rubra* P.B.M., *Young Churchman Misc.* 3: 383. Dec 1848. Validated by a description in English. – Thymelaeaceae. NOTE: The identity of the author "P.B.M." has not been determined.
- Davallia youngii* Veitch, *Gard. Chron.*, n.s., 3: 795. 19 Jun 1875. Validated by a brief description in English ("fronds cut into very fine segments"). – Davalliaceae.
- Deckeria nobilis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 162. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Delphinium candelabrum* Lebas, *Rev. Hort.* 46: 297. 1 Aug 1874. Validated by a diagnosis in French. – Ranunculaceae. NOTE: The name, *D. candelabrum* Ostenf. (in *Hedin*, *S. Tibet* 6(3): 80. 1922), is a later homonym, and as the name is in current use it will require conservation to be maintained.
- Dendrobium wallichianum* B.S.Williams, *Orch. Grow. Man.*, ed. 2, 98. Oct 1862. Validated by a diagnosis in English. – Orchidaceae.
- Dieffenbachia baraquimiana* W.Bull, *Proc. Roy. Hort. Soc.* 4:133. Jul 1864, *nom. illeg.* Validated by a description in English. – Araceae. NOTE: The name is not legitimate as *D. verschaffeltii* (Hort., *Proc. Roy. Hort. Soc.* 3:280. 29 Mai 1863, non Engl. [1879]) was cited in synonymy.
- Dipladenia × williamsii* B.S.Williams, *Gard. Chron.*, n.s., 1: 363. 21 Mar 1874. Validated by a description in English but no indication of parentage. – Apocynaceae.
- Dorema asafetida* (Falconer ex Lindl.) Haage & Schmidt, *Pl.-Verzeichn.* 4. Jan 1875, based on *Nartheex asafetida* Falconer ex Lindl, *Gard. Chron.* 1846: 743. 7 Nov 1846. – Apiaceae.
- Dracaena albicans* W.Bull, *Retail List [Wholesale List New Beautiful Rare Pl. 60:]* 23. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Dracaena × albo-marginata* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. nigrescens* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena × amalliae* T.Moore, *Gard. Chron.*, n.s., 4: 616. 13 Nov 1875 (*D. congesta* × unknown), as "*amallae*." Validated by a description in English. – Asparagaceae.
- Dracaena angusta* W.Bull, *Retail List [Wholesale List New Beautiful Rare Pl. 60:]* 23. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Dracaena × barronii* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. terminalis* × *D. regina*), as "*baroni*." Validated by a description in English. – Asparagaceae.
- Dracaena × bausei* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. chelonii* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena × bella* T.Moore, *Gard. Chron.*, n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. chelonii*). Validated by a description in English. – Asparagaceae.
- Dracaena × berkeleyi* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. excelsa* × *D. terminalis*). Validated by a description in English. – Asparagaceae.
- Dracaena candida* W.Bull, *Gard. Chron.*, n.s., 3: 474. 10 Apr 1875. Validated by a description in English. – Asparagaceae.
- Dracaena × cantrellii* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. excelsa* × *D. ferrea*). Validated by a description in English. – Asparagaceae.
- Dracaena × carolettiae* T.Moore, *Gard. Chron.*, n.s., 4: 615. 13 Nov 1875 (*D. concinna* × *D. regina*), as "*carolettae*." Validated by a description in English. – Asparagaceae.
- Dracaena dennisonii* Veitch ex E.Morren, *Belgique Hort.* 22: 353. Dec 1872. Validated by a brief description in French. – Asparagaceae.
- Dracaena demissonea* Veitch, *Cat. New Beautiful Pl.* 1873: 38. Jul-Aug 1873. Validated by a description in English. – Asparagaceae.
- Dracaena duffii* E.G.Hend., *Gard. Chron.*, n.s., 2: 722. 5 Dec 1874. Validated by a description in English. – Asparagaceae.

- Dracaena × elizabethiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. cooperi* × *D. regina*), as “*elizabethae*.” Validated by a description in English. – Asparagaceae.
- Dracaena × ernestii* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. terminalis*), as “*ernesti*.” Validated by a description in English. – Asparagaceae.
- Dracaena × eximia* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. excelsa* × *D. terminalis*). Validated by a description in English. – Asparagaceae.
- Dracaena × fredericii* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. excelsa* × *D. terminalis*), as “*frederici*.” Validated by a description in English. – Asparagaceae.
- Dracaena × fulgens* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. excelsa* × *D. terminalis*). Validated by a description in English. – Asparagaceae.
- Dracaena gemma* W.Bull, Gard. Chron., n.s., 3: 557. 1 Mai 1875. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena glonerea* Linden ex Rafarin, Rev. Hort. 46: 75. 16 Feb 1874. Validated by a diagnosis in French. – Asparagaceae.
- Dracaena grandis* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Asparagaceae.
- Dracaena × imperator* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. nigrescens* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena × jucunda* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. limbata* × *D. terminalis*). Validated by a description in English. – Asparagaceae.
- Dracaena × leucochila* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. cooperi* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena × mabiliae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. cooperi* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena × mastersii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. nigrescens* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena moorei* Veitch ex E.Morren, Belgique Hort. 22: 354. Dec 1872. Validated by a brief description in French. – Asparagaceae.
- Dracaena nigrorubra* Linden, Supp. Extrait Cat. Gén. 82/24: 7. 1 Jul 1869, as “*nigro-rubra*.” Validated by a diagnosis in French. – Asparagaceae.
- Dracaena nigrostriata* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874, as “*nigro-striata*.” Validated by a description in English. – Asparagaceae.
- Dracaena × pendens* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. cooperi* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena picta* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Asparagaceae.
- Dracaena × picturata* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. nigrescens* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena porphyrophylla* E.Morren, Belgique Hort. 22: 354. Dec 1872. Validated by a brief description in French. – Asparagaceae.
- Dracaena princeps* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Asparagaceae.
- Dracaena × rebeccaiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. cooperi* × *D. regina*), as “*rebeccaiae*.” Validated by a description in English. – Asparagaceae.
- Dracaena × renardiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. cooperi* × *D. regina*), as “*renardae*.” Validated by a description in English. – Asparagaceae.
- Dracaena rex* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Asparagaceae.
- Dracaena rubella* W.Bull, Gard. Chron., n.s., 3: 557. 1 Mai 1875. Validated by a diagnosis in English. – Asparagaceae.

- Dracaena* × *salmonae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *scottiae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena shepherdii* Hort., Gard. Chron. 1873: 6. 4 Jan 1873. Validated by a diagnosis in English. – Asparagaceae. NOTE: An alternative name for *D. gloriosa* (see below). See also: W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English.
- Dracaena shepherdii* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874, *nom. illeg.* Validated by a description in English. – Asparagaceae. NOTE: The name is a superfluous, alternative name for *D. gloriosa* Linden ex E. Morren (see below).
- Dracaena* × *sydneyi* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *taylori* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875 (*D. magnifica* × *D. mooreana*). Validated by a brief description in English (“dense-habited broad-leaved”). – Asparagaceae.
- Dracaena* × *tellingii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. ferrea* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *thomiae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. terminalis* × *D. concinna*), as “*thomae*.” Validated by a description in English. – Asparagaceae.
- Dracaena triumphans* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Asparagaceae.
- Dracaena* × *venusta* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. regina*), *nom. illeg.*, non Planch. (1850-1851). Validated by a description in English. – Asparagaceae.
- Dracaena verschaffeltii* Verschaff., Mag. Hort. Bot. 33: 187. Jun 1867. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena* × *versicolor* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. chelonii* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *victoriae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. concinna* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *violacea* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875 (*D. concinna* × *D. nigrescens*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *voluta* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. cooperi* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena* × *willii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. excelsa* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena youngii* E.Morren, Belgique Hort. 22: 354. Dec 1872. Validated by a brief description in French. – Asparagaceae.
- Drimyspermum australe* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 36. 1 Apr 1871. Validated by a diagnosis in English. – Thymelaeaceae.
- Duranta baumgarteni* K.Koch, Wochenschr. Vereines Beford. Gartenbaues Konigl. Preuss. Staaten 6: 47. 8 Feb 1862. Validated by a brief description in German (“eine Pflanze mit grün- und gelb-gezeichneten Blättern”). – Verbenaceae. NOTE: This plant was subsequently called *D. baumgartii*; see below.
- Duranta baumgartii* J.T.Hibbert, Gard. Chron., n.s., 3: 730. 5 Jun 1875. Validated by a brief description in English (“leaves are nicely margined with gold”). – Verbenaceae. NOTE: This seems to be an orthographic variant of *D. baumgarteni*; see above.
- Dyckia lematraeana* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Bromeliaceae.
- Dyckia splendens* Anderson., Gard. Chron., n.s., 4: 227. 21 Aug 1875. Validated by a brief description in English (“scarlet inflorescence”). – Bromeliaceae.

- Echeveria* × *carinata* W.Bull, Retail List [Spec. List *Gladiolus*. 68:] 14. Sep-Oct 1872 (*E. metallica* × *E. atropurpurea*). Validated by a diagnosis in English. – Crassulaceae.
- Echeveria* × *glaucometallica* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 151. 1 Apr 1871 (*E. secunda* var. *glauca* × *E. metallica*), as “*glauco-metallica*.” Validated by a diagnosis in English. – Crassulaceae.
- Echeveria* × *rotundifolia* R.Dean, Gard. Chron., n.s., 4: 627. 13 Nov 1875 (*E. glauca* var. *metallica* × *E. secunda* var. *major*). Validated by a brief description in English (“a flat-growing form, of a metallic green hue”). – Crassulaceae.
- Embothrium despardii* Hort., Gard. Chron., n.s., 3: 371. 20 Mar 1875. Validated by a description in English. – Proteaceae. NOTE: This name and description is in a published letter from “Ooshooia, Fireland, Patagonia” and signed by “B” about whom there is no more information.
- Entelea bakeri* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 36. 1 Apr 1871. Validated by a diagnosis in English. – Malaceae.
- Epidendrum hanburyanum* B.S.Williams, Orch. Grow. Man., ed. 2, 100. Oct 1862. Validated by a diagnosis in English. – Orchidaceae. NOTE: This might be an orthographic variant of *E. hanburii* Lindl., Edwards’s Bot. Reg. 30(Misc.): 46. 1844.
- Eremurus elwesianus* Krelage & Krelage, Krelage’s Bulbs, 472B: 101. 15 Jul 1894. Validated by a brief description in English (“robust spike, pink flowers”). – Xanthorrhoeaceae. NOTE: This name was used by Leichtlin (Garden (London) 38: 143. 9 Aug 1890) as a new name for *E. robustus* var. *nobilis* which was not validly published, and thus Leichtlin’s name is not validly published. Krelage and Krelage mentioned (“robustus var. nobilis”) but at least provided a brief description. The name, *E. elwesii* Micheli, Rev. Hort. 1897: 280. 16 Jun 1897, cited by IPNI, is a later orthographic variant; see the series of comments by Goverts (Gartenflora 48: 127–128. 1899), Wittmack (p. 128–129), and Krelage and son (p. 160).
- Eremurus* × *hem-rob* Tubergen, Cat. Flowerroots 18. Mai 1906 (*E. himalaicus* × *E. robustus*). Validated by a brief description in English (e.g., “pale rosy, immense spikes”). – Xanthorrhoeaceae.
- Eremurus* × *tubergenii* Tubergen, Cat. Flowerroots 18. Mai 1906 (*E. himalaicus* × *E. bungii*). Validated by a brief description in English (e.g., “pale yellow, growth and spikes like *himalaicus*”). – Xanthorrhoeaceae.
- Erica denisoniana* Hort., Gard. Chron., n. s., 1: 739. 6 Jun 1874. Validated by a description in English. – Ericaceae.
- Erica lindleyana* W.Holloway, Proc. Roy. Hort. Soc. 46: 159. Oct 1864. Validated by a description in English. – Ericaceae.
- Erinosma verum* (L.) Herb., Amaryllidaceae 331. late Apr 1837, based on *Leucojum verum* L., Sp. Pl. 1: 289. 1 Mai 1753. – Amaryllidaceae.
- Erythrina bogotensis* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Fabaceae.
- Ficus wendlandae* Rafarin, Rev. Hort. 46: 75. 16 Feb 1874. Validated by a description in French. – Moraceae.
- Fragaria bergemontis* Poit., Bon Jard. 235. 1837. Validated by a description in French. – Rosaceae.
- Fragaria duplex* Poit., Bon Jard. 235. 1837. Validated by a description in French. – Rosaceae.
- Fragaria eflagellosa* Poit., Bon Jard. 235. 1837. Validated by a description in French. – Rosaceae.
- Fritillaria odorata* Tubergen, Wholesale Cat. Flowerroots 19. 1892. Validated by a diagnosis in English (e.g., “dark purple” flowers – no other species so characterized). – Liliaceae.
- Fuchsia desideratum* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874. Validated by a description in English. – Onagraceae.
- Fuchsia grandidens* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874. Validated by a description in English. – Onagraceae.

- Funckia liliifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 47. 1 Apr 1871. Validated by a diagnosis in English. – Asparagaceae.
- Funckia platygynifolia* H.A.Dreer, Gard. Monthly Hort. 10: 64 [Hort. Advert. unpagd]. Feb 1868, as “*Funkia*.” Validated by a brief description in English (“Blue flowers”). – Asparagaceae.
- Geonoma purpurascens* Schaedtler, Hamburger Garten-Blumenzeitung 31: 166. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma tenelliana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 166. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Gleditsia subvirescens* Poit., Bon Jard. 893 [“93”]. 1837. Validated by a description in French. – Fabaceae.
- Gloxinia hieroglyphica* Wilh.Busch. ex Ed.Otto, Hamburger Garten-Blumenzeitung 31: 473. Oct 1875. Validated by a description in German. – Gesneriaceae.
- Goodyera dawsoniana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 66. 1 Apr 1871. Validated by a diagnosis in English. – Orchidaceae.
- Grias zamorensis* Linden, Cat. Pl. Exot. 22/23: 6. Jan-Jun 1869. Validated by a diagnosis in French. – Lecythidaceae.
- Griselinia macrophylla* (Hook.f.) Burb., Domestic Floricult. 287. 1874, based on *G. lucida* (J.R.Forst. & G. Forst.) G.Forst. var. *macrophylla* Hook.f., Handb. Fl. N. Zeal. Fl. 105. Sep-Oct 1864. – Griselinaceae. NOTE: There is no reference to the basionym but this obviously is a new combination. Nonetheless, there is also an excellent description in English. The name was published several times prior to 1874 (e.g., J. Robson, J. Hort. Cottage Gard. 32: 215. 13 Sep 1864) but all are here considered to be *nomen nuda*. In the case of the Robson name, however, if it were ever shown that the Hooker book was published prior to 13 Sep 1864, then Art. 33.3 would come into play and the name would be Validated a decade earlier than mentioned here.
- Gymnogramma* × *steinzeriana* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868 (*G. chrysophylla* × *G. lanata*), as “*Gymnogramme*.” Validated by a diagnosis in German. – Pteridaceae. NOTE: There is no indication that this is an orthographic variant of *G. stelzneri* K.Koch (Gärtnerei Pflanzenk. 2: 183. 1859) as the Laurentius name has an “i” instead of an “l” as the fourth letter in the Koch epithet.
- Heliconia vinosa* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 5. 1 Apr 1871. Validated by a description in English. – Heliconiaceae.
- Hemerocallis picta* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 26. 1 Apr 1871. Validated by a description in English. – Xanthorrhoeaceae.
- Hermione* Salisb. ex Haw., Suppl. Pl. Succ. 137. Mai 1819. Validated by a description in Latin. – Amaryllidaceae. NOTE: The Salisbury (Trans. Hort. Soc. London 1: 357. 1812) generic name is not validly published and thus none of his epithets is valid. Likewise, *Hermione* Salisb. ex Haw. (Syn. Pl. Succ. 329. 1812) is equally not validly published and thus none of Haworth’s epithets of 1812 are valid.
- Hibiscus albovariegata* W.Bull, Retail List [Spec. List Gladiolus. 68:] 14. Sep-Oct 1872, as “*albo-variegata*.” Validated by a diagnosis in English. – Malvaceae.
- Hibiscus carminata-perfecta* W.Bull, Retail List [Spec. List Gladiolus. 68:] 14. Sep-Oct 1872. Validated by a diagnosis in English. – Malvaceae.
- Hibiscus fulgidus* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Malvaceae.
- Hippeastrum oriflamme* B.S.Williams, Florist & Pomol. 27: 116. Mai 1874. Validated by a description in English. – Amaryllidaceae.
- Hippeastrum picturatum* W.Bull, Garden (London) 5: 176. 28 Feb 1874. Validated by a brief description in English (“white flowers striped with reddish-crimson”). – Amaryllidaceae.
- Huntleya wailletiae* B.S.Williams, Orch. Grow. Man., ed. 2, 109. Oct 1862. Validated by a description in English. – Orchidaceae.

- Hymenocalyx undulata* (Kunth) Houliet, Rev. Hort. 1869: 418. 1 Nov 1869, based on *Pancratium undulatum* Kunth in F.W.H.A. von Humboldt et al., Nov. Gen. Sp. 1: 280. late Aug 1816. – Amaryllidaceae.
- Hyophorbe madagascaariensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 167. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Hyospathe chiriqui* Schaedtler, Hamburger Garten-Blumenzeitung 31: 168. Apr 1875. Validated by a diagnosis in German. – Arecaceae. NOTE: This taxon may well have been named later as *H. chiriquensis* by Wendland (Palmiers 247. 1878).
- Imantophyllum barkeri* C.J.Barker, Gard. Chron., n.s., 1: 317. 7 Mar 1874. Validated by a description in English. – Amaryllidaceae.
- Iresine aureoreticulata* J.Saul, Gard. Monthly Hort. 10: 64 [Hort. Advert. 48]. Feb 1868, as “aureoreticulata.” Validated by a brief description in English (“Leaves beautifully reticulated”). – Amaranthaceae.
- Iris ciengtaltii* Tubergen, Wholesale Cat. Flowerroots 22. Mai 1901, as “ciengtalti.” Validated by a diagnosis in English (e.g., “Rhizomatous ... fine blue, dwarf”). – Iridaceae.
- Iris eggeri* Tubergen, Wholesale Cat. Flowerroots 23. Mai 1901. Validated by a diagnosis in English (e.g., “cushion iris ... blackbrown”). – Iridaceae.
- Jonquilla odora* Raf., Fl. Tellur. 4: 20–21. mid 1838, based on *Narcissus jonquilla* L., Sp. Pl. 1: 290. 1 Mai 1753. – Amaryllidaceae. NOTE: Haworth (Monogr. Narcissin. 7. 1 Jun 1831) proposed the genus and proposed three species, of which only *J. minor* Haw. can be traced unambiguously to *N. jonquilla* via the polynomial *Narcissus juncifolius luteus minor*. Accordingly, *J. minor* is designated here as the lectotype of *Jonquilla*. This then renders the Rafinesque an inadmissible name. See *Phylogyne* Haw., below.
- Kentia moorei* W.Bull, Garden (London) 5: 493. 6 Jun 1874. Validated by a brief description in English (“dark green pinnate [leaves]”). – Arecaceae. NOTE: This might be an orthographic variant of *K. mooreana* F.Muell. (Fragm. 7(54): 101. Apr 1870).
- Laelia maryanui* B.S.Williams, Orch. Grow. Man., ed. 2, 113. Oct 1862. Validated by a description in English. – Orchidaceae.
- Latania jenkinsiana* (Griff.) Devansaye, Rev. Hort. 47: 34. 16 Jan 1875, based on *Livistona jenkinsiana* Griff., Calcutta J. Nat. Hist. 5: 334. 1845. – Arecaceae.
- Latania olivaeformis* Devansaye, Rev. Hort. 47: 34. 16 Jan 1875. Validated by a diagnosis in French. – Arecaceae.
- Lecythis nobilis* Linden, Cat. Pl. Exot. 22/23: 26. Jan-Jun 1869. Validated by a diagnosis in French. – Lecythidaceae.
- Licuala orleyi* Schaedtler, Hamburger Garten-Blumenzeitung 31: 214. Mai 1875. Dubiously Validated by a diagnosis in German. – Arecaceae.
- Lilium wallacei* Tubergen, Wholesale Cat. Flowerroots 25. 1892. Validated by a diagnosis in English (e.g., “flowers yellow with black spots”). – Liliaceae.
- Lobelia gordonii* T.Moore, Proc. Roy. Hort. Soc. 4: 47, 195. Dec 1864. Validated by a description in English. – Campanulaceae. NOTE: The association of the epithet with the generic name is only made in the index (p. 195). Thus, the date of valid published is Dec 1864, not Feb 1864.
- Lobelia paxtoniana* T.Moore, Proc. Roy. Hort. Soc. 4: 47, 195. Dec 1864. Validated by a description in English. – Campanulaceae. NOTE: The association of the epithet with the generic name is only made in the index (p. 195). Thus, the date of valid published is Dec 1864, not Feb 1864.
- Lomaria dobroydensis* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Blechnaceae.
- Macrozamia australis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 306. Jul 1875. Validated by a diagnosis in German. – Zamiaceae.
- Martinezia nobilis* W.Bull, Garden (London) 8: 77. 24 Jul 1875. Validated by a brief description in English (“spinace petioles, free in growth”). – Arecaceae.
- Methonica senegalensis* Poit., Bon Jard. 507. 1837. Validated by a diagnosis in French. – Liliaceae.

- Methonica simplex* Poit., Bon Jard. 507. 1837. Validated by a diagnosis in French. – Liliaceae.
- Miconia argyoneura* Veitch, Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863. Validated by a description in English. – Melastomataceae.
- Miltonia morelii* B.S.Williams, Orch. Grow. Man., ed. 2, 119. Oct 1862. Validated by a diagnosis in English. – Orchidaceae. NOTE: Possibly an orthographic variant of *M. moreliana* Lindl. (Fol. Orchid. 5: 1. 1854).
- Mimosa conspicua* Poit., Bon Jard. 890. 1837. Validated by a description in French. – Fabaceae.
- Mimulus exquisitus* J.Muir, Garden (London) 6: 46. 18 Jun 1874. Validated by a diagnosis in English. – Phrymaceae.
- Mimulus meteor* J.Muir, Garden (London) 6: 46. 18 Jun 1874. Validated by a diagnosis in English. – Phrymaceae.
- Mimulus maculosus* J.Muir, Garden (London) 6: 46. 18 Jun 1874. Validated by a brief diagnosis in English (“yellow and crimson” flowers). – Phrymaceae.
- Morenia galeottiana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 218. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Morenia ruitzii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 218. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Musa africana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 6. 1 Apr 1871. Validated by a description in English. – Musaceae.
- Nepenthes cuneata* Veitch, Gard. Chron., n.s., 4: 368. 18 Sep 1875. Validated by a brief description in English ([pitcher] “with its fringe of large saw-tooth teeth”). – Nepenthaceae.
- Nerine amabilis* Tubergen, Wholesale Cat. Flowerroots 28. 1892. Validated by a diagnosis in English (e.g., “pale carmine rosy”). – Amaryllidaceae.
- Nerine* × *mitchamiae* Herb., Amaryllidaceae 283, 286, t. 43. late Apr 1837 (*N. curvifolia* × *N. undulata*). Validated by descriptions in Latin and English. – Amaryllidaceae.
- Nerium madonii* M.Vincent, J. Soc. Cent. Hort. France, sér. 2, 8: 184. 30 Apr 1875. Validated by a brief description in French (“semi-double, beau blanc”) and a proposed as a new name for *N. oleander* var. *alba* but no valid place of valid publication found for this potential basionym. – Apocynaceae.
- Odontoglossum caradenii* Veitch, Garden (London) 5: 256. 21 Mar 1874. Validated by a brief description in English (“pale yellow sepals and petals, and lip narrow, spotted with brown”). – Orchidaceae.
- Oeceoclades guineensis* W.Bull, Gard. Chron., n.s., 2: 309. 5 Sep 1874. Validated by a brief description in English (“with a large, broad, rosy lilac lip, and narrow sepals and petals”). – Orchidaceae.
- Oncidium batemanii* B.S.Williams, Orch. Grow. Man., ed. 2, 125. Oct 1862. Validated by a description in English. – Orchidaceae. NOTE: Possibly an orthographic variant of *O. batemanianum* J.Parm. ex Knowles & Westc. (Fl. Cab. 3: 183. 1840).
- Oncidium cavendishii* B.S.Williams, Orch. Grow. Man., ed. 2, 126. Oct 1862. Validated by a description in English. – Orchidaceae. NOTE: Possibly an orthographic variant of *O. cavendishianum* Bateman (Orchid. Mexico Guatemala ad t. 3. 1837).
- Oncidium krameri* J.Muir, Garden (London) 6: 384. 24 Oct 1874. Validated by a description in English. – Orchidaceae. NOTE: Possibly an orthographic variant of *O. kramertianum* Rehb.f. (Allg. Gartenzeitung 23: 9. 1855).
- Oncidium roezliianum* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 71. 1 Apr 1871. Validated by a diagnosis in English. – Orchidaceae.
- Pancratium notatum* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 28. 1 Apr 1871. Validated by a description in English. – Amaryllidaceae.
- Paphinia tigrina* B.S.Williams, Orch. Grow. Man., ed. 2, 131. Oct 1862. Validated by a description in English. – Orchidaceae.



- Pelargonium lycopodioides* Carrière, Rev. Hort. 46: 38. 16 Jan 1874. Validated by a description in French. – Geraniaceae.
- Pelargonium pseudozonale* Huber, Florist & Pomol. 28: 68. Mar 1875, as “*pseudo-zonale*”. Validated by a description in English. – Geraniaceae.
- Pelargonium × rienzi* Cannell ex T.Moore, Florist & Pomol. 28: 116. Mai 1875 (*P. inqumans* × *P. zonale*), as “*rienzi*”. Validated by a description in English. – Geraniaceae.
- Pelargonium sanguineum* Loisel., Herb. Gén. Amateur 5: ad t. 320. 1821, *nom. illeg.*, non J.C. Wendl. (1808). Validated by a description in Latin. – Geraniaceae. NOTE: There is no indication that this is anything but a new species, albeit a later homonym.
- Peperomia argentea* Sallier, Rev. Hort. 55: 323. 16 Jul 1883. Validated by a description in French. – Piperaceae.
- Pescatoria albosanguinea* W.Bull, Garden (London) 5: 538. 20 Jun 1874. Validated by a description in English. – Orchidaceae.
- Philodendron parimense* Linden ex Regel, Gartenflora 24: 175. 15 Jun 1875. Validated by a diagnosis in German. – Araceae.
- Phormium nigropictum* W.Bull, Retail List [Spec. List Gladiolus, 68:] 15. Sep-Oct 1872, as “*nigropictum*.” Validated by a diagnosis in English. – Xanthorrhoeaceae.
- Phylogyne* Salisb. ex Haw., Suppl. Pl. Succ. 132. Mai 1819. Validated by a diagnosis and a description in Latin. – Amaryllidaceae. NOTE: The genus name is cited by ING but not in IPNI. The name *Phylogyne* Salisb. (Trans. Hort. Soc. London 1: 355. 1812) cited by IPNI is not valid as Salisbury did not provide a generic description and accounted for more than a single species. Thus, none of the species (*Phylogyne conspicua*, p. 355, *Phylogyne heminalis*, p. 356, *Phylogyne calathina*, p. 356) is validly published contrary to the information in IPNI. In 1819, Haworth assigned six species to the genus of which *P. minor* Haw., Suppl. Pl. Succ. 137. Mai 1819, is designated here as the lectotype of the genus; this species is considered to be a synonym of *Narcissus jonquilla* L. Nonetheless, in 1831, Haworth reverted to the orthography of *Phylogyne*. See *Jonquilla odora*, above.
- Picea hookeriana* (A.Murray) Roetzl, Rev. Hort. 47: unpagd. 16 Feb 1875, based on *Abies hookeriana* A.Murray, Edinb. New Philos. J., n.s., 1: 289. Jan-Apr 1855. – Pinaceae.
- Picea lambertiana* (Douglas) F.Sander, Gard. Chron., n.s., 2: 702. 5 Dec 1874, based on *Pinus lambertiana* Douglas, Trans. Linn. Soc. London 15: 500. 11-20 Dec 1827. – Pinaceae.
- Picea magnifica* (A.Murray) F.Sanders, Gard. Chron., n.s., 2: 702. 5 Dec 1874, validated by a reference to *Abies magnifica* A.Murray, Proc. Roy. Hort. Soc. London 3: 318. 1863. – Pinaceae.
- Picea pyrenaica* E.Manning, Gard. Monthly Hort. 10: 109. Apr 1868. Validated by a brief description in English (“leaves over six inches long, very deep bright green”). – Pinaceae. NOTE: This might have been based on *Pinus pyrenaica* Lapeyr., Hist. Pl. Pyrénées 146. 1813 at which time Art. 33.3 could be cited to validate the name as a new combination.
- Plectocomia andersonii* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874, as “*andersoni*.” Validated by a description in English. – Arecaceae.
- Polianthes purpureus* R.Dean, Garden, 5: 298. 4 Apr 1874, as “*Polyanthus*.” Validated by a brief description in English. – Amaryllidaceae.
- Polygala dalmaisiana* T.Baines, Gard. Chron., n.s., 2: 617. 14 Nov 1874. Validated by a description in English. – Polygalaceae.
- Pothos endresii* Veitch, Gard. Chron., n.s., 4: 294. 4 Sep 1875. Validated by a brief description in English (“neat marbled leaves”). – Araceae.
- Pteris × serrulato-tremula* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874 (*P. serrulata* × *P. tremula*). Validated by a description in English. – Pteridaceae.
- Ptychosperma oliviformis* Schaedtler, Hamburger Garten-Blumenzeitung 31: Jun 252. 1875, as “*olivaeformis*.” Validated by a diagnosis in German. – Arecaceae.
- Punica legrellei* Haage & Schmidt, Pl.-Verzeichn. 2. Jan 1875. Validated by a description in German. – Lythraceae.

- Quercus salicifolia* Siebold ex J.W.Ottol., Gard. Chron., n.s., 1: 726. 6 Jun 1874, *nom. illeg.*, non Née (1801). Validated by a description in English. – Fagaceae.
- Reynoutria compacta* (Hook.f.) Nakai, Rigakkai 24: 293. 1926, based on *Polygonum compactum* Hook.f., Curtis's Bot. Mag. 106: ad t. 6476. 1880. – Polygonaceae.
- Rhododendron* × *ciliato-dauricum* Carrière, Rev. Hort. 46: 200. 16 Mai 1874 (*R. dauricum* × *C. ciliatum*). Validated by a description in French. – Ericaceae.
- Rosa* × *alpina-laevis* Rouen, Cat. Desc. Ros. 38. 1829, as “*alpina laevis*.” (*R. alpina* × *R. cinnamomea*). Validated by a description in French. – Rosaceae.
- Rosa apetala* Dupont ex Dum.-Cours., Bot. Cult., ed. 2, 5: 488. 1811. Validated by a diagnosis in French. – Rosaceae.
- Rosa atra* Rössig, Oekon.-Bot. Beschr. Rosen 1: 187. 1799. Validated by a description in German and Latin. – Rosaceae. NOTE: Proposed with an alternative name to *R. atropurpureascens*, see below.
- Rosa atropurpureascens* Rössig, Oekon.-Bot. Beschr. Rosen 1: 187. 1799. Validated by a description in German and Latin. – Rosaceae. NOTE: Proposed with an alternative name to *R. atra*, see above.
- Rosa bifera* (Poir.) Pers., Syn. Pl. 2: 48. Nov 1806, based on *R. centifolia* var. *bifera* Poir. Encycl. 6(1): 276. 2 Oct 1804. – Rosaceae. NOTE: The IPNI entry, “*Rosa bifera* Poir.” is not correct as the name was proposed at the rank of variety as given here.
- Rosa bracteata* Andrews, Roses 2: ad t. 87. 1827, *nom. illeg.*, non J.C.Wendl. (1798). Validated by a description in Latin. – Rosaceae.
- Rosa caerulea* Guillemeau, Hist. Nat. Rose 93. 1800. Validated by a description in French. – Rosaceae.
- Rosa calycina* Rössig, Oekon.-Bot. Rosen 1: 124. 1799. Validated by a description in German. – Rosaceae.
- Rosa cannabina* Pronville, Nomencl. Rosier 53. Nov-Dec 1818. Validated by a description in French. – Rosaceae.
- Rosa* × *carbonara* Rouen, Cat. Desc. Ros. 214. 1829. Validated by a description in French. – Rosaceae.
- Rosa ciliata* Bosc, Nouv. Nouv. Agric. Dict. Rais. Agric. 11: 250. 1809. Validated by a description in French. – Rosaceae.
- Rosa clynophylla* Thory in P.J. Redouté, Roses 1: 43. 24 Mai 1817. Validated by a description in Latin. – Rosaceae.
- Rosa dicksoniana* Lindl., Syn. Brit. Fl. 99. Feb 1829. Validated by a description in English. – Rosaceae. NOTE: Possibly an orthographic variant of *R. dicksonii* Lindl. (Trans. Hort. Soc. London 7: 224. 1830).
- Rosa euonymifolia* Chesnel, Hist. Rose 113. 1820, as “*evonymifolia*.” Validated by a description in French. – Rosaceae.
- Rosa formosa* Breiter, Hort. Breiter 422. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 19. 1814. – Rosaceae.
- Rosa fraxinifolia* Dupont ex Dum.-Cours., Bot. Cult. 3: 352. 1-4 Jul 1802, *nom. illeg.*, non Borkh. (1791), associated with a diagnosis in French. – Rosaceae.
- Rosa fraxinifolia* F.Dietr., Vollst. Lex. Gärtn. 8: 233. Sep 1808, *nom. illeg.*, non Borkh. (1790). Validated by a diagnosis in German. – Rosaceae.
- Rosa fraxinifolia* Pronville, Nomencl. Rosier 54. Nov-Dec 1818, *nom. illeg.*, non Borkh. (1790). Validated by a description in French. – Rosaceae.
- Rosa glanduloso-calcina* Opiz, Lotos 4: 47. Feb 1854. Validated by a description in German. – Rosaceae.
- Rosa glanduloso-punctata* Opiz, Lotos 4: 69. Mar 1854. Validated by a description in German. – Rosaceae.

- Rosa glauca* Fr., Novit. Fl. Svec. 35. 11 Mai 1814, *nom. illeg.*, non Pourr. (1788). Validated by a description in Latin. – Rosaceae.
- Rosa hardyana* Poit., Bon Jard. 864. 1837. Validated by a diagnosis in French. – Rosaceae.
- Rosa heterocarpa* Opiz, Flora 7(2): 525. 7 Sep 1824. Validated by a description in Latin. – Rosaceae.
- Rosa hybrida* Tratt., Rosac. Monogr. 1: 62. Jul-Dec 1823, *nom. illeg.*, non Vill. (1788). Validated by a description in Latin. – Rosaceae.
- Rosa inermis* Thory in P.J. Redouté, Roses [Oct.] 1: Livr. 16a. 1824, *nom. illeg.*, not Delaun. ex Mill. (1768). Validated by a diagnosis in Latin and a description in French. – Rosaceae.
- Rosa lacteola* Breiter, Hort. Breiter 425. Jan-Oct 1817, *nom. illeg.* Validated by diagnoses in Latin associated with a Bauhin and a John Ray phrase name. – Rosaceae. NOTE: The name is not legitimate as the author included *R. lactea* Loisel., J. Bot. 2: 337. 1809, and *R. mutabilis* Dum.-Cours., Bot. Cult., ed. 2, 5: 475. 1811 in synonymy.
- Rosa lanceolata* Rössig, Oekon.-Bot. Rosen 1: 162. 1799. Validated by diagnoses in German and Latin. – Rosaceae.
- Rosa mosceuton* Guillemeau, Hist. Nat. Rose 92. 1800. Validated by a description in French. – Rosaceae.
- Rosa multiflora* Rössig, Oekon.-Bot. Rosen 68. 1799, *nom. illeg.*, non Thunb. (1784). Validated by diagnoses in German and Latin. – Rosaceae. NOTE: Proposed as an alternative name for *P. polyanthos* Rössig, Oekon.-Bot. Rosen 1: 68. 1799, *nom. illeg.*, validated by diagnoses in German and Latin and proposed as an alternative name for *R. multiflora* Thunb. (Fl. Jap. 214. 1784) and thus even this new name is not legitimate.
- Rosa mundi* Andrews, Roses 1: 46. 1805, as “*Mundi*.” Validated by diagnoses in Latin and English. – Rosaceae. NOTE: Proposed as a new and alternative name for *R. gallica* var. *variegata* Andrews, Roses 1: 46. 1805, *nom. illeg.*, non Guillemeau, Hist. Nat. Rose 60. 1800.
- Rosa ntens* Bechst., Forstbot., ed. 4, 158, 607. 1821, *nom. illeg.*, non Desv. (1812), based on *R. canina* var. *ramosissima* A.Rau, Enum. Ros. Wirecb. 74. Mar-Dec 1815. – Rosaceae.
- Rosa noisettaeana* Loisel., Herb. Gén. Amateur 5: ad t. 288. 1821. Validated by a description in Latin. – Rosaceae. NOTE: Almost certainly an orthographic variant of *R. noisetana* Redouté (Roses 2: 77. 1820). The later Bosc (Encycl. Méth. Agric. 6: 705. 1821) cited by IPNI, was Validated by a reference to a description in French associated with the expression “Le Rosier à feuilles odorantes”, the common name often associated with *R. rubiginosa* L., published by A. Parmentier (in J. Rozier, Cours Compl. Agric., ed. 2, 11: 261. 1809).
- Rosa obovata* Bechst., Forstbot., ed. 4, 159, 675. 1821, *nom. illeg.*, non Raf. (1820). Validated by a diagnosis and a description in German. – Rosaceae.
- Rosa pulchella* Andrews, Roses 1: 57. 1817, *nom. illeg.*, non Salisb. (1798). Validated by diagnoses in Latin and English. – Rosaceae.
- Rosa saintfrancisci* Rössig, Oekon.-Bot. Beschr. Rosen 2: 61. 1803, as “*St. Francisci*.” Validated by descriptions in German and Latin. – Rosaceae.
- Rosa × serratifolia* Rouen, Cat. Desc. Ros. 232. 1829. Validated by a description in Latin. – Rosaceae.
- Rosa sultana* Rössig, Oekon.-Bot. Beschr. Rosen 2: 51. 1803. Validated by descriptions in German and Latin. – Rosaceae.
- Rosa syringorosea* Rössig, Oekon.-Bot. Rosen 2: 34. 1803, as “*Syringo-rosea*.” Validated by descriptions in German and Latin. – Rosaceae.
- Rosa tenera* Breiter, Hort. Breiter 431. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 12. 1814. – Rosaceae.
- Rosa terebinthina* (Thory) Tratt., Rosac. Monogr. 1: 111. Jul-Dec 1823, *nom. illeg.*, non Besser (1822), based on *R. villosa* var. *terebinthina* Thory in P.J. Redouté, Roses 2: 71. 8 Jul 1820. – Rosaceae.
- Rosa versicolor* Tratt., Rosac. Monogr. 2: 124. Jul-Dec 1823, *nom. illeg.*, non Steud. (1821). Validated by a diagnosis and description in Latin. – Rosaceae.

- Ruellia pitcairniifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 41. 1871, as “*pitcairnaefolia*.” Validated by a diagnosis in English. – Acanthaceae.
- Sabal warszewiczii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 254. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Samyda nobilis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871. Validated by a description in English. – Salicaceae.
- Sarracenia flavopurpurea* B.S.Williams, Garden (London) 5: 400. 9 Mai 1874, as “*flavo-purpurea*.” Validated by a diagnosis in English. – Sarraceniaceae. NOTE: Suggested as a possibly naturally occurring hybrid between *S. rubra* and *S. purpurea* so that this might be rendered *Sarracenia* × *flavopurpurea*.
- Saurauia superba* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 5. Aug 1868. Validated by a diagnosis in German. – Actinidiaceae.
- Saxifraga aromatica* Niven, Garden (London) 5: 349. 18 Jul 1874. Validated by a diagnosis in English. – Saxifragaceae.
- Saxifraga germanica* Niven, Garden (London) 5: 284. 4 Apr 1874. Validated by a diagnosis in English. – Saxifragaceae.
- Saxifraga huettni* Vilm.-Audricux, J. Soc. Cent. Hort. France, sér. 2, 8: 226. 31 Mai 1874. Validated by a brief description in French (“...petite plant à fleurs jaunes...”). – Saxifragaceae.
- Scabiosa parnassiae* Hort., Gard. Chron. 1873: 1175. 30 Aug 1873, as “*parnassae*.” Validated by a brief description in English. – Caprifoliaceae.
- Scilla hughii* Mast. & T.Moore, Gard. Chron., n. s., 1: 26. 3 Jan 1874. Validated by a diagnosis in English. – Asparagaceae.
- Scutellaria moccimiana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871. Validated by a description in English. – Lamiaceae.
- Seaforthia alexandriae* Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Seaforthia excelsa* Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Sedum californicum* E.G.Hend., Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Crassulaceae.
- Selaginella ascendens* Baker, Garden (London) 6: 407. 31 Oct 1874. Validated by a description in English. – Selaginellaceae.
- Selaginella griffithii* Baker, Garden (London) 6: 407. 31 Oct 1874. Validated by a brief description in English (“an elegant creeping species, the tips of the fronds of which are gracefully recurved”). – Selaginellaceae.
- Selaginella inaequalifolia* Baker, Garden (London) 6: 407. 31 Oct 1874. Validated by a description in English. – Selaginellaceae.
- Selaginella japonica* Moore ex M’Nab, Trans. Proc. Bot. Soc. Edinburgh 9: 8. Jan-Mar 1867. Validated by a description in English. – Selaginellaceae.
- Selaginella poulteri* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 6. Aug 1868. Validated by a diagnosis in German. – Selaginellaceae.
- Selaginella setosa* Linden, Cat. Pl. Exot. 22/23: 9. Jan-Jun 1869. Validated by a diagnosis in French. – Selaginellaceae.
- Senecio giesbreghtii* Brongn. ex Clémenc., Rev. Hort. 46: 100. 1 Mar 1874. Validated by a poor organized description in French. – Asteraceae.
- Sennebia pinnatifida* Poit., Bon Jard. 294. 1837. Validated by a description in French. – Brassicaceae. NOTE: The generic name is not legitimate but the epithet is valid.
- Socratea affinis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Socratea squitos* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875. Validated by a diagnosis in German. – Arecaceae.

- Sophora pendula* Ounous, Rev. Hort. 46: 280. 16 Jul 1874. Validated by a description in French. – Fabaceae.
- Spathiphyllum macrophyllum* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a diagnosis in French. – Araceae.
- Sphaerogyne ferruginea* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871. Validated by a description in English. – Melastomataceae.
- Spondias olivaeformis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 31. 1 Apr 1871. Validated by a description in English. – Anacardiaceae.
- Stephensonia sechallara* (H.Wendl.) R.Hogg, Florist & Pomol. 133. Jun 1865, as “*Stevensonia sechallarum*,” based on *Phoenicophorum sechallarum* H.Wendl., Ill. Hort. 12: Misc. 5. 1865. – Arecaceae.
- Struthiopteris japonica* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 121. 1 Apr 1871. Validated by a description in English. – Blechnaceae.
- Synechanthus gracilis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Synechanthus sarapiquensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Theophrasta andrea* Linden ex Rafarin, Rev. Hort. 46: 76. 16 Feb 1874. Validated by a description in French. – Primulaceae.
- Thuja defresneana* C. van Geert ex K.Koch, Wochensch. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 119. 11 Apr 1863. Validated by a diagnosis in German. – Cupressaceae.  
NOTE: An alternative name for *Biota defresneana* (see below).
- Tritoma abyssinica* (Redouté) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Veltheimia abyssinica* Redouté, Lilac. 4: ad t. 186. 1807. – Xanthorrhoeaceae. NOTE: The basionym is often ascribed to DC. However Redouté only mentions “*Veltheimia abyssinica* Vel. *Du Mus. D’Hist. nat.* 8. 55.”
- Tritoma breviflora* (Harv. ex Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia breviflora* Harv. ex Baker, J. Linn. Soc., Bot. 11: 361. 1870. – Xanthorrhoeaceae.
- Tritoma comosa* (Hochst.) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia comosa* Hochst., Flora 27(1): 31. 1844. – Xanthorrhoeaceae.
- Tritoma gracilis* (Harv. ex Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia breviflora* Harv. ex Baker, J. Linn. Soc., Bot. 11: 362. 1870. – Xanthorrhoeaceae.
- Tritoma grantii* (Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia grantii* Harv. ex Baker, J. Linn. Soc., Bot. 11: 363. 1870. – Xanthorrhoeaceae.
- Tritoma isoetifolia* (A.Rich) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia isoetifolia* A.Rich., Tent. Fl. Abyss. 2: 324. 1850. – Xanthorrhoeaceae.
- Tritoma parviflora* (Kunth) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia parviflora* Kunth, Enum. Pl. 4: 553. 23-29 Mai 1841. – Xanthorrhoeaceae.
- Tritoma porphyrantha* (Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia porphyrantha* Baker, J. Bot. 12: 4. 1874. – Xanthorrhoeaceae.
- Tritoma praecox* (Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia praecox* Baker, Refug. Bot. 3: ad t. 169. Jan 1870. – Xanthorrhoeaceae.
- Tritoma quartiniiana* (A.Rich) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia isoetifolia* A.Rich., Tent. Fl. Abyss. 2: 324. 1850. – Xanthorrhoeaceae.
- Tritoma rigidissima* W.Mast., Garden (London) 5: 500. 13 Jun 1874. Validated by a description in English. – Xanthorrhoeaceae.
- Tritoma schimperii* (Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia schimperii* Baker, J. Bot. 12: 4. 1874. – Xanthorrhoeaceae.
- Tritoma triangularis* (Kunth) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia triangularis* Kunth, Enum. Pl. 4: 551. 23-29 Mai 1841. – Xanthorrhoeaceae.

- Tropaeolum pyramidalis* H.A.Dreer, Gard. Monthly Hort. 10: 64 [Hort. Advert. unpag.]. Feb 1868. Validated by a description in English. – Tropaeolaceae.
- Tulipa viridiflora* Tubergen, Wholesale Cat. Flowerroots 11. 1892. Validated by a diagnosis in English (e.g., “green flowered”). – Liliaceae.
- Urceolaria fulva* Herb., Amaryllidaceae 194, pl. 26, f. 5. Dec 1837, *nom. inadmis.* Validated by a description in English. – Colchicaceae.
- Uvularia sinensis* Loudon, Gardener’s Mag. 8: 111. Feb 1832, *nom. illeg.*, based on *Disporum fulvum* D.Don, Prodr. Fl. Nepal 5: 50. 26 Jan-1 Feb 1825. – Colchicaceae.
- Vaccinium mortenianum* J.M’Nab, Garden (London) 6: 206. 29 Aug 1874. Validated by a brief description in English. – Ericaceae. NOTE: Based on M’Nab’s statement that this “is a beautiful new evergreen species” it is assumed that this is not an orthographic variant of *V. mortiniana* Benth. (Pl. Hartw. 221. 1846).
- Vanda pygmaea* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 20. Aug 1868, a new base based on *Oeceoclades falcata* Lindl., Gen. Sp. Orchid. Pl. 237 1833, non *V. falcata* Beer (1854). – Orchidaceae.
- Vitis zongyhioides* D.Thomson, Gardener 8: 102. Mar 1874. Validated by a description in English. – Vitaceae.
- Wallichia oblongata* Regel, Gartenflora 24: 177. Jun 1875. Validated by description in German. – Arecaceae.
- Weigela graciliflora* Carrière, Rev. Hort. 47: 211. 1 Jun 1875. Validated by a description in French. – Caprifoliaceae.
- Weigela hendersonii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 54. 1871, as “hendersoni.” Validated by a description in English. – Caprifoliaceae.
- Weigela hybrida* Carrière, Rev. Hort. 47: 211. 1 Jun 1875. Validated by a diagnosis in French. – Caprifoliaceae.
- Weigela lemoinei* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 54. 1 Apr 1871. Validated by a description in English. – Caprifoliaceae.
- Weigela multiflora* Carrière, Rev. Hort. 47: 210. 1 Jun 1875. Validated by a description in French. – Caprifoliaceae.
- Weigela mutabilis* Carrière, Rev. Hort. 1861: 331. 1861. Validated by a description in French. – Caprifoliaceae.
- Weigela nivea* Carrière, Rev. Hort. 47: 130. 1 Apr 1875. Validated by a description in French. – Caprifoliaceae.
- Weigela striata* B.K.Bliss, Hort. J. Rural Arts Rural Taste 17: 10. Apr 1862. Validated by a description in English. – Caprifoliaceae.
- Weigela vanhouttii* B.K.Bliss, Hort. J. Rural Arts Rural Taste 17: 10. Apr 1862. Validated by a description in English. – Caprifoliaceae.
- Zamia plumosa* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874. Validated by a description in French. – Zamiaceae.

#### NAMES WITH AN EARLIER REFERENCE THAN CURRENTLY IN IPNI

- Abies commutata* A.Murray, Gard. Chron., n.s., 3: 106. 23 Jan 1875. Validated by a brief, and somewhat dubious diagnosis in English but also considered the name to be a new name for *Abies menziesii argentea*, but if this name was Validated before the above date, it has not been found and, frankly, does not seem to have been Validated prior to 23 Jan 1875. – Pinaceae.
- Abies hanburyana* A.Murray, Garden (London) 6: 272. 19 Sep 1874, *nom. illeg.*, a new name for *A. pattoniana* Jeffrey ex A. Murr., Bot. Exped. Oregon Circ. 2: 1, t. 4, fig. 2. 1850. – Pinaceae.
- Acanthophoenix grandis* André, Rev. Hort. 67: 250. 1 Jun 1895. Validated by a diagnosis in French. – Arecaceae.

- Acanthorrhiza* Linden, Cat. Pl. Exot. 22/23: 47. Jan-Jun 1869, as "*Acanthorhiza*." T.: *A. warscewiczii* Linden. – Arecaceae.
- Acanthorrhiza warscewiczii* Linden, Cat. Pl. Exot. 22/23: 47. Jan-Jun 1869, as "*Warscewiczii*." Validated by a diagnosis in French. – Arecaceae.
- Acer athense* G.Gordon, Garden (London) 5: 83. 24 Jan 1874. Validated by a description in English. – Sapindaceae.
- Adiantum elegantissimum* B.S.Williams ex R.Hogg, Florist & Pomol. 27: 135. Jun 1874. Validated by a description in English. – Adiantaceae.
- Adiantum gracillimum* B.S.Williams ex R.Hogg, Florist & Pomol. 27: 42. Feb 1874. Validated by a description in English. – Adiantaceae.
- Adiantum hendersonii* E.C.Hend., Gard. Chron. 1873: 570. 26 Apr 1873. Validated by a description in English. – Adiantaceae.
- Aerides fieldingii* B.S.Williams, Orch. Grow. Man., ed. 2, 39. Oct 1862. Validated by a description in English. – Orchidaceae.
- Aerides huttonii* (Hook.f.) Veitch, Cat. New Beautiful Pl. 1873: 16. Jul-Aug 1873, based on *Saccolabium huttonii* Hook.f., Curtis's Bot. Mag. 93: ad t. 5681. 1 Dec 1867. – Orchidaceae.
- Aerides lobbiai* B.S.Williams, Orch. Grow. Man., ed. 2, 39. Oct 1862. Validated by a description in English. – Orchidaceae.
- Aerides nobilis* B.S.Williams, Orch. Grow. Man., ed. 2, 40. Oct 1862, as "*nobile*." Validated by a description in English. – Orchidaceae. NOTE: See also R.Warner, Select Orchid. Pl., ser. 1, ad t. 10. Sep-Nov 1862, as "*nobile*." Validated by a description in English.
- Aerides veitchii* B.S.Williams, Orch. Grow. Man., ed. 2, 41. Oct 1862. Validated by a description in English. – Orchidaceae.
- Aerides williamsii* B.S.Williams, Orch. Grow. Man., ed. 2, 43. Oct 1862. Validated by a description in English. – Orchidaceae.
- Aesculus rubicunda* Loisel., Herb. Gén. Amateur 6: ad t. 357. 1822. Validated by a description in Latin. – Sapindaceae.
- Agave bulbosa* W.Bull., Retail List [Wholesale List New Beautiful Rare Pl. 60:] 3. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Agave gucaefolia* Mannetti in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 380. 1834. Validated by a description in Italian. – Asparagaceae.
- Agave gustaviana* Haage & Schmidt, Pfl.-Cat. 1874: 1. Jan 1874. Validated by a diagnosis in German. – Asparagaceae.
- Alphanes bicuspidata* (H.Karst.) Ed.Otto, Hamburger Garten-Blumenzeitung 31: 24. Jan 1875, based on *Marara bicuspidata* H.Karst., Linnaea 28: 390. Jun 1857. – Arecaceae.
- Ajax cernuus* Haw., Philos. Mag., n.s., 8: 131. Aug 1830, a new name for *Narcissus cernuus* Roth, Catal. Bot. 1: 43. Jan-Feb 1797, *nom. illeg.*, non Salisb. (1796). – Amaryllidaceae.
- Ajax lorifolius* Haw., Suppl. Pl. Succ. 119. Mai 1819. Validated by a diagnosis in Latin. – Amaryllidaceae.
- Ajax minor* (L.) Haw., Suppl. Pl. Succ. 112. Mai 1819, based on *Narcissus minor* L., Sp. Pl., ed. 2, 415. Sep 1762. – Amaryllidaceae.
- Ajax moschatus* (L.) Haw., Suppl. Pl. Succ. 118. Mai 1819, based on *Narcissus moschatus* L., Sp. Pl., ed. 2, 1: 415. Sep 1762. – Amaryllidaceae.
- Ajax namus* Haw. in R. Sweet, Brit. Fl. Gard., ser. 2, 25(App.): 2. 1 Jun 1831, based on *A. minor* var. *conspicuous* Haw., Suppl. Pl. Succ. 112. Mai 1819. – Amaryllidaceae.
- Ajax propinquus* (Salisb.) Haw., Suppl. Pl. Succ. 116. Mai 1819, based on *Narcissus propinquus* Salisb., Prodr. Stirp. Chap. Allerton 221. Nov-Dec 1796. – Amaryllidaceae.
- Ajax serratus* (Haw.) Haw., Suppl. Pl. Succ. 114. Mai 1819, based on *Narcissus serratus* Haw., Misc. Nat. 179. Jul-Dec 1803. – Amaryllidaceae.
- Ajax tortuosus* (Haw.) Haw., Philos. Mag., n.s., 8: 131. Aug 1830, based on *Narcissus tortuosus* Haw., Misc. Nat. 179. Jul-Dec 1803. – Amaryllidaceae.

- Alnus imperialis* (Hemsl.) Rob., Gard. Chron., n.s., 2: 334. 12 Sep 1874. Validated by brief description in English and a reference to *A. glutinosa* var. *imperialis* Hemsl., Handb. Trees 415. 1873. – Betulaceae.
- Alocasia* × *chantrieri* Andre in Rev. Hort. [Paris], 59: 465, f. 92. 16 Oct 1887. – Araceae.
- Alocasia gibsonii* E.C.Hend., Gard. Chron. 1873: 604. 3 Mai 1873, as “*Calocasia Gibsonii*.” Validated by a description in English. – Araceae.
- Alocasia illustris* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Araceae.
- Alocasia plumbea* van Houtte, Fl. Serres 21: 93. 1 Oct 1875, *nom. illeg.* Validated by a description in French. – Araceae. NOTE: The name is not legitimate by virtue of the inclusion of *A. cuprea* (K.Koch & Bouché) K.Koch, Wochenschr. Vereines Beförd. Bartenbaues Königl. Preuss. Staaten 4: 141. 1861, based on *Caladium cupreum* K.Koch & Bouché, App. Gen. Sp. Nov. 1854: 6. 1855.
- Aloe greenii* Green, Garden (London) 8: 77. 24 Jul 1875. Validated by a description in English. – Xanthorrhoeaceae.
- Alpinia vittata* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Zingiberaceae.
- Alsophila beyrichiana* (C. Presl) G., Garden (London) 5: 160. 21 Feb 1874, based on *Hemitelia beyrichiana* C.Presl, Abh. Boehm. Ges. Wiss. V. 5: 353. 1848. – Cyatheaceae.
- Alsophila elegantissima* Linden, Cat. Pl. Exot. 22/23: 57. Jan-Jun 1869. Validated by a diagnosis in French. – Cyatheaceae.
- Alstroemeria bredemeyera* Willd. ex Schult. & Schult.f., Syst. Veg. 7(1): 751. 1829. Validated by a description in Latin. – Alstroemeriaceae.
- Amaryllis caplyprata* Ker Gawl., Bot. Reg. 2: ad t. 164. 1 Jan 1817. Validated by a description in Latin. – Amaryllidaceae.
- Amaryllis citrina* Sibth. & Sm., Fl. Graec. Prodr. 1: 221. Mai-Nov 1809. Validated by a description in Latin. – Amaryllidaceae.
- Amaryllis chusiana* Ker Gawl., Curtis's Bot. Mag. 27: ad t. 1089. 1 Mar 1808. Validated by a diagnosis in Latin, that being the phrase name used by Clusius. – Amaryllidaceae.
- Amaryllis colchiciflora* (Waldst. & Kit.) Ker Gawl., Curtis's Bot. Mag. 27: ad t. 1089. 1 Mar 1808, based on *Sternbergia colchiciflora* Waldst. & Kit., Descr. Icon. Pl. Hung. 2: 172, t. 159. 1804. – Amaryllidaceae.
- Amaryllis grandiflora* (Lindl.) Herb., Amaryllidaceae 278. late Apr 1837, based on *Brunsvigia grandiflora* Lindl., Edwards's Bot. Reg. 16: 1335. 1 Jul 1830. – Amaryllidaceae.
- Amaryllis tettau* Haage & Schmidt, Pfl.-Cat. 1874: 1. Jan 1874. Validated by a diagnosis in German. – Amaryllidaceae.
- Ampelopsis veitchii* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 6. Aug 1868. Validated by a diagnosis in German. – Vitaceae. NOTE: The current IPNI record lists Hort., Gard. Chron. 1868: 814. 1 Aug 1868, *nom. prov.*, a name associated with a diagnosis in English.
- Ananas mordilona* Linden, Cat. Pl. Exot. 22/23: 2. Jan-Jun 1869. Validated by a diagnosis in French. – Bromeliaceae.
- Anguloa mantinii* André, Rev. Hort. 67: 249. 1 Jun 1895, as “*martini*.” Validated by a diagnosis in French. – Anemniaceae. NOTE: The same name was proposed by C. Maron at the same time but on p. 250; this is in IPNI.
- Anoectochilus javanicus* (Blume) B.S.Williams, Orch. Grow. Man., ed. 2, 49. Oct 1862, based on *Hetaertia javanica* Blume, Bijdr. Fl. Ned. Ind. 8: 410. 20 Sep-7 Dec 1825. – Orchidaceae. NOTE: The basionym was not cited, but validate by the provisions in Art. 33.3. Also, the name was associated with a description in English.
- Anoectochilus zebrinum* W.Bull, Proc. Roy. Hort. Soc. 4: 9. Jan 1864. Validated by a description in English. – Orchidaceae.



- Anthericum variegatum* B.S.Williams, Gard. Chron., n.s., 3: 442. 3 Apr 1875. Validated by a brief description in English ("with white margins to its long green leaves"). – Asparagaceae. NOTE: The Williams name can be exactly dated. Any exact date for the current IPNI record (Flor. Mag., t. 152. 1875) could not be determined.
- Anthurium candidum* W.Bull, Gard. Chron., n.s., 3: 491. 17 Apr 1875. Validated by a description in English. – Asparagaceae. NOTE: Also in Bull's Catalogue as noted in IPNI but when the catalogue was published could not be determined.
- Anthurium hybridum* B.S.Williams ex Rob., Garden (London) 5: 276. 28 Mar 1874. Validated by a description in English. Also: B.S.Williams, Florist & Pomol. 27: 115. Apr 1874. Validated by a description in English. – Asparagaceae. NOTE: The Williams name predates that of Engler (Monogr. Phan. 2: 191. 1879). A taxonomic decision is necessary to determine if the original material associated with the Williams name at Kew represents the same entity as described by Engler.
- Anthurium williamsi* Hort., Gardener 8: 198. Mai 1874. Validated by a diagnosis in English. – Asparagaceae.
- Aralia guilfoylei* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Araliaceae.
- Aralia laciniata* Rafarin, Rev. Hort. (Paris) 49: 326. 1 Sep 1877. Validated by a brief diagnosis in French ("à feuilles très-découpées"). – Araliaceae. NOTE: An alternative name, *Panax laciniatus* Rafarin (Rev. Hort. 49: 326. 1 Sep 1877, as *laciniatum*), *nom. illeg.*, was also proposed (as "*Aralia laciniata* ou *Panax laciniatum*"). *Panax laciniatus* Rob., Garden (London) 9: 436. 1 Jun 1876 is probably validly published although it is associated only by the expression "cut-leaved" and "elegant habit" is not much better than what is in Revue Horticole so it is possible that the Rafarin name might be considered a new combination (via Art. 33.3). The 1876 reference for *P. laciniatus* now in IPNI (e.g., Gard. Chron., n.s., 6: 372. 16 Sep 1876) is not correct as the name is a *nomen nudum*.
- Aralia sieboldii* T.Meehan, Gard. Monthly Hort. 10: 24. Jan 1868. Validated by an unorganized description in English. – Araliaceae.
- Aralia veitchii* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873. Validated by a description in English. – Araliaceae.
- Arbutus croomii* Rob., Garden (London) 6: 442. 14 Nov 1874, as "*Croomii*." Validated by a diagnosis in English. – Ericaceae.
- Artocarpus calophylla* Haage & Schmidt, Pfl.-Cat. 1874: 1. Jan 1874. Validated by a diagnosis in German. – Moraceae.
- Artocarpus cannonii* Veitch, Gard. Chron., n.s., 4: 242. 21 Aug 1875. Validated by a diagnosis in English. – Moraceae.
- Artocarpus grandis* Linden ex Cazuola & Nencioni, Coltiv. Piante Ornam., ed. 2, 222. 1889. Validated by a diagnosis in Italian. – Moraceae. NOTE: Only the second edition seen and the first edition was not seen and thus not checked.
- Asparagus albanensis* André, Rev. Hort. 67: 249. 1 Jun 1895. – Asparagaceae.
- Astrocaryum filare* W.Bull, Gard. Chron., n.s., 3: 491. 17 Apr 1875. Validated by a description in English. – Arecaceae.
- Bactris caravellana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Bactris cucullata* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Bactris diplothemium* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Bactris elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.

- Bactris martineziformis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 67. Feb 1875, as “*martineziaeformis*.” Validated by a diagnosis in German. – Arecaceae.
- Bactris obovata* H.Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Bactris spinosissima* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 67. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Begonia diadem* W.Bull., *Retail List* [Wholesale List New Beautiful Rare Pl. 60:] 138. 1 Apr 1871. Validated by a description in English. – Begoniaceae.
- Begonia* × *hybrida* P.W.Burbridge, *Cultivated Pl.* 202. 1877 (*B. manicata* × *B. coccinea*). Validated by a description in English. – Begoniaceae.
- Begonia vesuvius* Veitch, *Garden* (London) 4: 204. 6 Sep 1873. Validated by a diagnosis in English. – Begoniaceae. NOTE: Not published as a hybrid, but so indicated in 1874 (e.g., Florist & Pomol. 27: 201. Sep 1874), but the parentage not stated.
- Begonia weltonensis* W.Bull., *Retail List* [Wholesale List New Beautiful Rare Pl. 60:] 139. 1 Apr 1871. Validated by a description in English. – Begoniaceae.
- Bertolonia* × *marchandii* T.Moore, *Florist & Pomol.* 28: 143. Jun 1875. Validated by a description in English. – Melastomataceae.
- Biota aurea* (Carrière) K.Koch, *Dendrologie* 2(2): 183. Nov 1873, based on *Thuja aurea* Carrière, *Traité Gén. Conif.*: 96. 1855. – Cupressaceae. NOTE: See also *B. aurea* (Carrière) Mast. & T.Moore, *Gard. Chron.*, n. s., 1: 60. 10 Jan 1874, an isonym. Also see *Thuja defresneana* (above).
- Biota defresneana* C. van Geert ex K.Koch, *Wochensch. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten* 6: 119. 11 Apr 1863. Validated by a diagnosis in German. – Cupressaceae. NOTE: An alternative name for *Thuja defresneana* (see above).
- Blumenbachia coronata* Rob., *J. Hort. Pract. Gard.* 25: 216. 18 Sep 1873. Validated by a brief diagnosis in English (“orange flowers”). – Loasaceae.
- Bocconia japonica* Haage & Schmidt, *Pl. Cat.* 36. Jan 1870. Validated by a description in German. – Papaveraceae.
- Bocconia jodoensis* Carrière, *Rev. Hort.* 37: 340. 15-31 Aug 1866. Validated by a description in French. – Papaveraceae. NOTE: This name predates *Macleaya jodoensis* (Carrière) E.André, *Rev. Hort.* 37: 369. 15-30 Sep 1866, as “*Macleaya yedoensis*”), and as this combination was based on *B. jodoensis* Carrière, the current orthography in IPNI (“*Macleaya yedoensis*”) should be corrected.
- Brahea filamentosa* H.Wendl., *Rev. Hort.* 47: unpag. 16 Aug 1875. Validated by a description in French. – Arecaceae. NOTE: This is in an advertisement by Haage & Schmidt; see also the following isonyms: Veitch, *Gard. Chron.*, n.s., 4: 294. 4 Sep 1875. Validated by a description in English. Also described in *Gartenflora* 24: 361. 1 Dec 1875.
- Brahea ghiesbreghtii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 68. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Brahea lucida* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 69. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Brahea nitida* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 69. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Brassica rutabaga* Vilm., *Bon Jard.* 345. 1837. Validated by a diagnosis in French. – NOTE: Brassicaceae.
- Brizia compacta* H.A.Dreer, *Gard. Monthly Hort.* 10: 64 [Hort. Advert. unpag.]. Feb 1868. Validated by a description in English. – Poaceae.
- Brugmansia lutea* Hort., *Paxton's Mag. Bot.* 4: 95. 1838. Validated by a description in English. – Solanaceae.
- Burlingtonia knowlesi* B.S.Williams, *Orch. Grow. Man.*, ed. 2, 63. Oct 1862. Validated by a description in English. – Orchidaceae.

- Caesalpinia alternifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 19. 1 Apr 1871. Validated by a description in English. – Fabaceae.
- Caladium lilliputianum* André, Rev. Hort. 67: 250. 1 Jun 1895. Validated by a brief description in French. – Araceae.
- Calamus dealbatus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 123. 1 Apr 1871. Validated by a description in English. – Arecaceae.
- Calamus nicolai* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Calamus obovoides* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Calyptrogyne elata* Rafarin, Rev. Hort. 46: 76. 16 Feb 1874. Validated by a description in French. – Arecaceae.
- Calyptrogyne sarapiquensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875. Validated by a diagnosis in German. – Arecaceae.
- Campanula* × *smithii* Hort., Gard. Chron., n.s., 2: 83. 18 Jul 1874 (*C. fragilis* × *C. pumila* var. *alba*). Validated by a description in English. – Campanulaceae. NOTE: Name attributed to a “Mr. Smith” See also *Campanula* × *smithii* Smith, Garden (London) 6: 63. 18 Jul 1874. Validated by a diagnosis in English. See also the note of the parentage in Garden 6: 79. 25 Jul 1874.
- Campsidum filicifolium* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Bignoniaceae.
- Carica aurantiaca* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Caricaceae.
- Carica gracilis* Linden, Cat. Pl. Exot. 22/23: 24. Jan-Jun 1869. Validated by a diagnosis in French. – Caricaceae.
- Carladovica lancaefolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875. Validated by a diagnosis in German. – Cyclanthaceae.
- Carladovica rotundifolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875. Validated by a diagnosis in German. – Cyclanthaceae.
- Caryota elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Caryota majestica* Schaedtler, Hamburger Garten-Blumenzeitung 31: Mar 111. 1875. Validated by a diagnosis in German. – Arecaceae.
- Cattleya amabilis* B.S. Williams, Orch. Grow. Man., ed. 2, 63. Oct 1862. Validated by a description in English. – Orchidaceae.
- Cattleya edithiana* B.S. Williams, Orch. Grow. Man., ed. 2, 70. Oct 1862. Validated by a description in English. – Orchidaceae.
- Cattleya* × *irrorata* (Rehb.f.) Low, Proc. Roy. Hort. Soc. 4: 8. Jan 1864, based on *Laelia irrorata* Rehb.f. in Hamb., Gartenz. 15: 57. 1859. – Orchidaceae.
- Centropogon lucyanus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 19. 1 Apr 1871. Validated by a diagnosis in English. – Campanulaceae.
- Ceroxylon ferrugineum* Devansaye, Rev. Hort. 46: 214. 1 Jun 1874. Validated by a description in French. – Arecaceae.
- Ceroxylon niveum* Hort., Gard. Chron., n.s., 1: 255. 21 Feb 1874. Validated by a description in English. – Arecaceae.
- Chamaedorea elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 114. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaedorea ghesbreghtii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 114. Mar 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaedorea hartwegii* B., Garden (London) 6: 368. 17 Oct 1874. Validated by a diagnosis in English. – Arecaceae. NOTE: The note is simply signed “B.”

- Chamaedorea obovoidea* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 155. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Chamaedorea wendlandii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 156. Apr 1875, as “Wendlandi.” Validated by a diagnosis in German. – Arecaceae.
- Chamaerops ghiesbreghtii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 157. Apr 1875, as “Ghiesbreghtii.” Validated by a diagnosis in German. – Arecaceae.
- Chloraster fissus* Haw., *Philos. Mag.* J. 63: 103. Feb 1824. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Chloraster integer* Haw., *Philos. Mag.* J. 63: 104. Feb 1824. Validated by a diagnosis in Latin. – Amaryllidaceae.
- Cibotium regale* Verschaff. ex Regel in *Gartenfl.* 14: 251. Aug-Sep 1865. Validated by a diagnosis in German. – Cibotiaceae.
- Clematis × henryi* Anderson-Henry ex T. Moore & Jackman, *Clematis* 106. Sep-Dec 1872 (*C. lanuginosa* × *C. fortunei*). Validated by a description in English. – Ranunculaceae. NOTE: Predates the IPNI record for *C. henryi* Hort., *Gard. Chron.* 10: 439. 5 Oct 1878; see below.
- Clematis henryi* Oliv., Hooker’s *Icon. Pl.* 19: ad t. 1819. Jan 1889, *nom. illeg.*, non *C. henryi* Hort., *Gard. Chron.* 10: 439. 5 Oct 1878, validated by a brief description in English (“robust habit, good foliage, and large white flowers...”). – Ranunculaceae. NOTE: See *Clematis × henryi* (see above).
- Clematis monstrosa* Jackman, *Florist & Pomol.* 5: 201. Jul 1855. Validated by a description in English. – Ranunculaceae.
- Clematis × rubro-violacea* Jackman, *Florist & Pomol.* 3: 265. 1864 (*C. lanuginosa* × *C. viticella*). Validated by a description in English. – Ranunculaceae.
- Clematis sophia* Hérincq, *Hort. Franç.* 1854: 31, pl. 3. 1854. Validated by a diagnosis and a fragmented description in French. – Ranunculaceae.
- Clematis × splendida* Barral, *Rev. Hort.* 1865: 70, fig. 16 Feb 1865 (*C. lanuginosa* × *C. viticella* var. *grandiflora*). Validated by a description in French. – Ranunculaceae.
- Clematis stella* Jackman ex T. Moore & Jackman, *Clematis* 144. Sep-Dec 1872. Validated by a description in English. – Ranunculaceae.
- Clematis sylph* Cripps, *Florist & Pomol.* 3: 166. Jul 1870 or *Gardener* 1870: 323. Jul 1870. Validated by a brief description in English. – Ranunculaceae. NOTE: A more exact date either publication could be established.
- Clematis tumbridgensis* R. Dean, *Gardener* 2: 359. Sep 1867. Validated by a brief description in English (“reddish purple, with a blue stripe up each segment”). – Ranunculaceae.
- Cocos elegantissima* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 158. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Colchicum giganteum* Tubergen, *Wholesale Cat. Flowerroots* 17. 1903. Validated by a diagnosis in English (e.g., “large dark lilac”). – Colchicaceae.
- Colpothrinax wrightii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Cooperia drummondiana* Herb., *Amaryllidaceae* 178. late Apr 1837, *nom. illeg.*, a new name for *C. drummondii* Herb., *Edwards’s Bot. Reg.* 22: ad t. 1835, 1 Feb 1836. – Amaryllidaceae.
- Copernicia barbadensis* (Lodd. ex Mart.) Devansaye, *Rev. Hort.* 47: 35. 16 Jan 1875, based on *Thrinax barbadensis* Lodd. ex Mart., *Hist. Nat. Palm.* 3: 320. 1839. – Arecaceae.
- Copernicia macroglossa* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Copernicia robusta* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875. Validated by a diagnosis in German. – Arecaceae. NOTE: The Devansaye (*Rev. Hort.* 47: 35. 16 Jan 1875) reference is not considered to be valid: Très-belle plante don’t les feuilles ont un aspect qui le milieue entre celui *L[atania] olivaeformis* et du *Pritchardia pacifica*.

- Corbularia albicans* Haw., Syn. Pl. Succ. 332. 1812. Validated by a description in Latin. – Amaryllidaceae.
- Cordylone banksii* J.Dix, Proc. Roy. Hort. Soc. 4:133, Jul 1864, *nom. illeg.* Validated by a description in English. – Asparagaceae. NOTE: This later homonym may or may not be the same plant described by Hooker in 1860; see also Gartenflora 1864: 13. 1864.
- Coreopsis elegans* Loisel., Herb. Gén. Amateur 7: ad t. 450. 1824. Validated by a description in Latin. – Asteraceae.
- Corypha glauca* Devansaye, Rev. Hort. 47: 32. 16 Jan 1875, *nom. illeg.*, based on *Corypha glaucescens* Lodd. ex Loudon, Hort. Brit. 125. 1830. – Arecaceae. NOTE: Although Devansaye cited “*Sabal glaucescens*” (a synonym cited under *C. glaucescens* “Lodd. ex Mart., Hist. Nat. Palm. 3: 247, 1839”), the reference is thus indirect to the above basionym and the Devansaye name is still not legitimate as it is also superfluous.
- Corypha martiana* Devansaye, Rev. Hort. 47: 32. 16 Jan 1875, *nom. illeg.*, based on *Pritchardia martinii* H.Wendl., Bonplandia 10: 199. 1862. – Arecaceae.
- Coryphanthes speciosa* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862. Validated by a description in English. – Orchidaceae.
- Crimum anomalum* Herb., Curtis’s Bot. Mag. 47: ad t. 2121. 1 Jan 1820. Validated by a description in Latin. – Amaryllidaceae.
- Crimum brevifolium* Herb., Curtis’s Bot. Mag. 47: ad t. 2121. 1 Jan 1820, *nom. illeg.* Validated by a brief diagnosis in Latin. – Amaryllidaceae.
- Crimum macrocarpon* Herb., Curtis’s Bot. Mag. 47: ad t. 2121. 1 Jan 1820. Validated by a diagnosis in English. – Amaryllidaceae.
- Crimum makoyanum* E.C.Hend., Gard. Chron. 1873: 534. 19 Apr 1873. Validated by a description in English. – Amaryllidaceae.
- Crimum procerum* Herb., Curtis’s Bot. Mag. 47: ad t. 2121. 1 Jan 1820. Validated by a diagnosis in English. – Amaryllidaceae.
- Crimum venustum* Carey ex Herb., Appendix 22. late Dec 1821. Validated by a diagnosis in Latin. – Amaryllidaceae.
- Crimum verecundum* Carey ex Herb., Appendix 22. late Dec 1821. Validated by a diagnosis in Latin. – Amaryllidaceae.
- Croton cornutus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 20. 1 Apr 1871, as “*cornutum*.” Validated by a diagnosis in English. – Euphorbiaceae.
- Croton hillianus* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869, as “*hillianum*.” Validated by a diagnosis in French. – Euphorbiaceae.
- Croton interruptus* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868, as “*interruptum*.” Validated by a description in German. – Euphorbiaceae.
- Croton irregularis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871, as “*irregularis*.” Validated by a diagnosis in English. – Euphorbiaceae.
- Croton picturatum* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English. – Euphorbiaceae.
- Croton tortile* Veitch, Gard. Chron., n.s. 3: 474. 10 Apr 1875. Validated by a description in English. – Euphorbiaceae.
- Croton undulatus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871, as “*undulatum*.” Validated by a diagnosis in English. – Euphorbiaceae.
- Croton weismannii* Veitch, Gard. Chron. 1868: 659. 1868. Validated by a description in English. – Euphorbiaceae.
- Cupressus balfouriana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 45. 1 Apr 1871. Validated by a diagnosis in English. – Cupressaceae.
- Cyclanthus estaba* Schaedtler, Hamburger Garten-Blumenzeitung 31: 302. Jul 1875. Validated by a diagnosis in German. – Cyclanthaceae.

- Cydonia maulei* W.Earley, Florist & Pomol. 27: 281. Dec 1874. Validated by a description in English. – Rosaceae.
- Cytisus everestianus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 35. 1 Apr 1871. Validated by a description in English. – Fabaceae.
- Davallia tyermanii* (T.Moore) Veitch, Cat. New Beautiful Pl. 1873: 18. Jul-Aug 1873, based on *Humata tyermanii* T.Moore [not in IPNI] or Validated by a diagnosis in English. – Davalliaceae.
- Davallia truffautiana* André, Rev. Hort. 67: 250. 1 Jun 1895. Validated by a diagnosis in French. – Davalliaceae.
- Delphinium alopecuroides* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 46. 1 Apr 1871. Validated by a diagnosis in English. – Ranunculaceae.
- Dendrobium × ainsworthii* W.Mitch., Garden (London) 5: 176. 21 Feb 1874 (*D. nobile* × *D. heterocarpum*). Validated by a description in English. – Orchidaceae.
- Dendrobium citrinum* W.Bull, Garden (London) 5: 502. 13 Jun 1874. Validated by a diagnosis in English. – Orchidaceae.
- Dendrobium eburneum* Low, Proc. Roy. Hort. Soc. 4: 8. Jan 1864. Validated by a description in English. – Orchidaceae.
- Dendrobium parishii* Low, Proc. Roy. Hort. Soc. 3:281. 29 Mai 1863. Validated by a description in English. – Orchidaceae. NOTE: The name *D. parishii* Rehb.f., Bot. Zeitung 21: 236. 31 Jul 1863 is a later homonym. An even later homonym (*D. parishii* Bateman, Bot. Mag. 91: ad t. 5488. 1 Jan 1865) is also cited in IPNI with the name attributed to Reichenbach and dated 1863 rather than 1865.
- Dieffenbachia antioquiensis* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a brief description in French (“feuilles vert foncé, légèrement maculées”). – Araceae.
- Dieffenbachia eburnea* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 22. 1 Apr 1871. Validated by a description in English. – Araceae.
- Dieffenbachia gigantea* Verschaff. ex Regel in Gartenfl. 14: 250. Aug-Sep 1865. Validated by a description in German. – Araceae.
- Dieffenbachia grandis* W.Bull, Proc. Roy. Hort. Soc. 4:133. Jul 1864. Validated by a diagnosis in English. – Araceae.
- Dieffenbachia nobilis* Verschaff. ex Regel in Gartenfl. 14: 251. Aug-Sep 1865. Validated by a brief description in German. – Araceae.
- Dieffenbachia parlatoresii* Hort., Gard. Chron., n.s., 1: 665. 23 May 1874. Validated by a description in English. – Araceae.
- Dieffenbachia pearcei* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868. Validated by a description in German. – Araceae.
- Dieffenbachia verschaffeltii* Hort., Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863. Validated by a description in English. – Araceae.
- Dieffenbachia wallisii* Linden, Cat. Pl. Exot. 22/23: 4. Jan-Jun 1869, as “wallisi.” Validated by a diagnosis in French. – Araceae.
- Diglossophyllum serrulatum* (Michx.) H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 162. Apr 1875, based on *Chamaerops serrulata* Michx., Fl. Bor.-Amer. 1: 206. 19 Mar 1803. – Arecaceae.
- Dioscorea illustrata* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Dioscoreaceae.
- Diospyros mazellii* Carrière, Rev. Hort. 46: 70. 16 Feb 1874. Validated by a description in French. – Ebenaceae.
- Dipladenia brearleyana* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874. Validated by a description in English. – Apocynaceae.
- Disteganthus scarlatinus* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a description in French. – Bromeliaceae.

- Doryanthes palmeri* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Amaryllidaceae.
- Dracaena alborosea* W.Bull, Gard. Chron., n.s., 2: 160. 8 Aug 1874, as “albo-rosea.” Validated by a diagnosis in English. – Asparagaceae.
- Dracaena* × *anerleyensis* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875 (*D. terminalis* × *D. regina*). Validated by a description in English. – Asparagaceae.
- Dracaena excelsa* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 23. 1 Apr 1871, nom. illeg., non Ten. (1838). Validated by a description in English. – Asparagaceae.
- Dracaena formosa* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena fraseri* Hort., Gard. Chron. 1873: 5. 4 Jan 1873. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena gloriosa* Hort., Gard. Chron. 1873: 6. 4 Jan 1873. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena goldieana* Hort., Gard. Chron. 1873: 5. 4 Jan 1873. Validated by a brief description in English. – Asparagaceae.
- Dracaena guilfoylei* Moore ex Linden, Supp. Extrait Cat. Gén. 82/24: 6. 1 Jul 1869. Validated by a diagnosis in French. – Asparagaceae.
- Dracaena hendersonii* Veitch, Gard. Chron., n.s., 1: 531. 25 Apr 1874, as “hendersoni.” Validated by a description in English. – Asparagaceae.
- Dracaena* × *hybrida* W.Bull ex R.Hogg, Florist & Pomol. 27: 158. Jul 1874 (*D. magnifica* × *D. albicans*). Validated by a description in English. – Asparagaceae.
- Dracaena illustris* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a diagnosis in English. – Asparagaceae.
- Dracaena impatiens* Hort., Gard. Chron. 1873: 5. 4 Jan 1873. Validated by a brief description in English. – Asparagaceae.
- Dracaena insignis* W.Bull, Gard. Chron., n.s., 3: 474. 10 Apr 1875. Validated by a description in English. – Asparagaceae.
- Dracaena intermedia* E.C.Hend., Gard. Chron. 1873: 498. 12 Apr 1873. Validated by a description in English. – Asparagaceae.
- Dracaena macleayi* Linden, Supp. Extrait Cat. Gén. 82/24: 7. 1 Jul 1869. Validated by a diagnosis in French. – Asparagaceae.
- Dracaena magnifica* Veitch ex E.Morren, Belgique Hort. 22: 15. Jan 1872. Validated by a brief description in French. – Asparagaceae.
- Dracaena mooreana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Dracaena pulchella* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Dracaena spectabilis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871. Validated by a description in English. – Asparagaceae.
- Dracaena splendens* W.Bull ex E.Morren, Belgique Hort. 22: 15. Jan 1872. Validated by a brief description in French. – Asparagaceae.
- Dracaena striatifolia* E.C.Hend., Gard. Chron. 1873: 498. 12 Apr 1873. Validated by a description in English. – Asparagaceae.
- Dracaena weismannii* Veitch, Gard. Chron. 1871: 841. 1 Jul 1871. Validated by a description in English. – Asparagaceae.
- Dryopteris nobilis* J.Douglas, J. Hort. Cottage Gard. 11: 459. 18 Dec 1866. Validated by a description in English. – Dryopteridaceae. NOTE: The 1941 Ching name requires conservation to be maintained.
- Echeveria abyssinica* W.Bull, Retail List [Spec. List Gladiolus. 68:] 13. Sep-Oct 1872. Validated by a description in English. – Crassulaceae.

- Echeveria exima* E.G.Hend. ex R.Hogg, Florist & Pomol. 27: 136. Jun 1874. Validated by a description in English. – Crassulaceae.
- Echeveria globosa* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874. Validated by a diagnosis in French. – Crassulaceae.
- Echeveria peacockii* J.Croucher, Gard. Chron., n.s. 1: 674. 23 May 1874. Validated by a description in English. – Crassulaceae.
- Epidendron syringothyrsus* Veitch, Cat. New Beautiful Pl. 1873: 19. Jul-Aug 1873. Validated by a description in English. – Orchidaceae.
- Eranthemum aureoreticulatum* Veitch, Garden (London) 5: 276. 28 Mar 1874. Validated by a description in English. – Acanthaceae.
- Eranthemum rubronennum* Veitch, Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863. Validated by a diagnosis in English. – Acanthaceae.
- Eremospatha* Mann & H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 163. Apr 1875. T: *E. macrocarpa* Mann & H.Wendl. ex Schaedtler. Validated by a single description (Art. 42.1). – Arecaceae.
- Eremospatha macrocarpa* Mann & H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 163. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Erythrina compacta* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 4. 1 Apr 1871. Validated by a diagnosis in English. – Fabaceae.
- Erythrina fulgens* Loisel., Herb. Gén. Amateur 4: ad t. 247. 1820. Validated by a description in Latin. – Fabaceae.
- Erythrina parcellii* Dombrain, Flor. Mag., n.s., 3: ad t. 95. Dec 1873. Validated by a description in English. – Fabaceae.
- Eucharis amazonica* R.Hogg, Florist Fruitist Gard. Misc. 1856: 228. Aug 1856. Validated by a brief description in English (“...beautiful white flowers which are large in size and very showy”). – Amaryllidaceae.
- Euonymus flavescens* W.Paul., Gardener 2: 383. Oct 1867. Validated by a brief diagnosis in English (“shoot all yellow”). – Celastraceae.
- Euterpe antioquiensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 163. Apr 1875, *nom. illeg.* Associated with a diagnosis in German but not legitimate as proposed as a new name for *E. montana* Graham, Bot. Mag. 67: ad. t. 3874. 1841. – Arecaceae.
- Euterpe decurrens* Schaedtler, Hamburger Garten-Blumenzeitung 31: 164. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Euterpe zamora* Schaedtler, Hamburger Garten-Blumenzeitung 31: 164. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Ficus dealbata* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868. Validated by a description in German. – Moraceae. NOTE: See also Linden, Supp. Extrait Cat. Gén. 82/24: 7. 1 Jul 1869. Validated by a diagnosis in French.
- Ficus parcellii* Veitch, Gard. Chron., n.s., 1: 531. 25 Apr 1874. Validated by a description in English. – Moraceae.
- Fittonia gigantea* Linden, Cat. Pl. Exot. 22/23: 5. Jan-Jun 1869. Validated by a diagnosis in French. – Acanthaceae. NOTE: Possibly predates the IPNI record; Rev. Hort. 186. 16 Mai 1869.
- Freesia leichtliniana* Klatt ex Rob., Garden (London) 6: 215. 5 Sep 1874. Validated by a brief description in English (“yellow and orange-coloured flowers deliciously scented”). – Iridaceae. NOTE: *Freesia leichtlinii* Klatt (Gartenflora 23: 289, t. 808. Oct 1874) is here considered to be an orthographic variant.
- Gaussia portoricensis* H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 164. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma amazonica* Schaedtler, Hamburger Garten-Blumenzeitung 31: 164. Apr 1875. Validated by a diagnosis in German. – Arecaceae.



- Geonoma longipes* Schaedtler, Hamburger Garten-Blumenzeitung 31: 165. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma longipes* Schaedtler, Hamburger Garten-Blumenzeitung 31: 165. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma tenuifolia* André, Rev. Hort. 67: 250. 1 Jun 1895. Validated by a diagnosis in French. – Arecaceae.
- Geonoma verschaffeltii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 166. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma wallisii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 166. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Geonoma zamorensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 166. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Gladiolus × brenchleyensis* Hort, Ann. Hort.: 523. Sep 1848 (*G. psittacicus* × *floribundus*). Validated by a brief description in English. – Iridaceae.
- Gladiolus oppositiflorus* Herb., Amaryllidaceae 366. late Apr 1837. Validated by a diagnosis in English. – Iridaceae.
- Glaziova insignis* Rob., Gard. Chron., n.s., 1: 665. 23 May 1874. Validated by a description in English. – Arecaceae.
- Gloxinia hybrida* Mountjoy, Floric. Cab. & Florist's Mag. 8: 156. 1840. Validated by a brief description in English ("soft blue flowers"). – Gesneriaceae. NOTE: If this is considered dubious, the name was Validated numerous times after 1840 and there are a whole series of varital names associated with the binomial, including some proposed before 1840 (e.g., *Gloxinia hybrida* var. *purpurascens* and var. *richteri* in 1836) suggesting that the binomial may even predate 1840.
- Goodyera dawsonii* Boxall, Garden (London) 6: 197. 29 Aug 1874. Validated by a diagnosis in English. – Orchidaceae.
- Goodyera × domini* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862. Validated by a description in English. – Orchidaceae. NOTE: Hybrid parentage not stated.
- Goodyera picta* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862. Validated by a description in English. – Orchidaceae.
- Goodyera rubrovenia* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862, as "*rubo-venia*." Validated by a description in English. – Orchidaceae. NOTE: It is possible the later *G. rubovena* Boxall ex Naves, Nov. App. 248. 1880 is an orthographic variant.
- Gymnogramma pearcei* Veitch, Proc. Roy. Hort. Soc. 4: 72. Apr 1864, as "*pearci*." Validated by a description in English. – Pteridaceae.
- Habranthus robustus* Herb. in R. Sweet, Brit. Fl. Gard. ser. 2. 1: ad t. 14. 1 Sep 1829. Validated by a description in Latin. – Amaryllidaceae. NOTE: While Herbert later (Amaryllidaceae 166. late Apr 1837) cited *Amaryllis tubispatha* L'Her. (Sert. Angl. 9. Mai 1790), this was not mentioned in 1829 and thus the name is not superfluous when published. Contrary to IPNI there is no direct evidence that this name was proposed by Herbert in Loddiges Botanical Cabinet.
- Haemanthus cooperi* E.G.Hend., Garden (London) 5: 430. 16 Mai 1874. Validated by a description in English. – Amaryllidaceae.
- Heraclium leichtlinii* Haage & Schmidt, Pl. Cat. 36. Jan 1870, as "Leichtlini." Validated by a description in German. – Apiaceae.
- Hermione jasmineea* Salisb. ex Haw., Philos. Mag., n.s., 8: 133. Aug 1830. Validated by a description in English and the citation of pre-Linnaean phrase names associated with an effectively published but not valid R.A. Salisbury (Trans. Hort. Soc. London 1: 357. 1812, as "*Hermione jasmineea*") name. – Amaryllidaceae.
- Hermione lacticolor* Haw. in R. Sweet, Brit. Fl. Gard., ser. 2. 25(App.): 10. 1 Jun 1831. Validated by a description in Latin. – Amaryllidaceae.

- Hippeastrum ambiguum* Herb., Curtis's Bot. Mag., n.s. 11: ad t. 3542. 1 Jan 1837. Validated by a description in Latin. – Amaryllidaceae.
- Hippeastrum breviflorum* Herb., Curtis's Bot. Mag., n.s. 11: ad t. 3549. 1 Feb 1837. Validated by a description in Latin. – Amaryllidaceae.
- Hippeastrum striatifolium* (Herb.) Herb., Appendix 34. Dec 1821, based on *Amaryllis reticulata* var. *striatifolia* Herb., Bot. Mag. 47: ad t. 2113. 1 Dec 1819. – Amaryllidaceae.
- Indigofera atropurpurea* Buch.-Ham. Ex Hornemann, Hort. Bot. Hafn. Suppl. 152. 1819. Validated by a description in Latin. – Fabaceae.
- Indigofera bilabiata* Loisel., Herb. Gén. Amateur 6: ad t. 392. 1822. Validated by a description in Latin. – Fabaceae.
- Iriarteia gigantea* Schaedtler, Hamburger Garten-Blumenzeitung 31: 168. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Ixora* × *colei* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 167. 1871 (*I. coccinea* × *I. alba*). Validated by a description in English. – Rubiaceae.
- Ixora dixiana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 26. 1 Apr 1871. Validated by a description in English. – Rubiaceae.
- Ixora fraseri* Rob., Gard. Chron., n.s., 2: 83. 18 Jul 1874. Validated by a description in English. – Rubiaceae. NOTE: See also *Ixora* × *fraseri* Fraser, Garden (London) 6: 63. 18 Jul 1874. Validated by a diagnosis in English.
- Juglans macrophylla* Haage & Schmidt, Pfl.-Cat. 1874: 4. Jan 1874. Validated by a diagnosis in German. – Juglandaceae.
- Juglans segraisiensis* M.B.Verlot, J. Soc. Cent. Hort. France, sér. 2, 8: 281. 30 Jun 1875. Validated by a brief description in French ("...à fruits allongées..."). – Juglandaceae.
- Justicia lutea* Loisel., Herb. Gén. Amateur 6: ad t. 403. 1822. Validated by a description in Latin. – Acanthaceae.
- Kennedia fredwoodii* W.Bull, Proc. Roy. Hort. Soc. 4: 21. Feb 1864, as "*Kennedya*". Validated by a diagnosis in English. – Fabaceae.
- Kentia balmoreana* Rafarin, Rev. Hort. 46: 76. 16 Feb 1874. Validated by a description in French. – Arecaceae.
- Laelia gigantea* R.Warner, Proc. Roy. Hort. Soc. 2: 247. Mai 1862. Validated by a description in English. – Orchidaceae.
- Lastrea floridana* (Hook.) K.Koch, Wochenschr. Vereines Beford. Gartenbaues Konigl. Preuss. Staaten 12: 143. 8 Mai 1869, based on *Nephrodium floridamum* Hook., Fil. Exot. ad t. 99. 1859. – Thelypteridaceae.
- Latama glaucophylla* Schaedtler, Hamburger Garten-Blumenzeitung 31: 170. Apr 1875. Validated by a diagnosis in German. – Arecaceae.
- Lathyrus stibhorpii* Haage & Schmidt, Pfl.-Cat. 1874: 4. Jan 1874. Validated by a diagnosis in German. – Fabaceae.
- Ledenbergia roseo-aenea* Lem. ex Linden, Suppl. Extrait Cat. Gén. 82/24: 8. 1 Jul 1869. Validated by a diagnosis in French. – Phytolaccaceae.
- Leptopteris intermedia* G., Garden (London) 5: 414. 16 May 1874. Validated by a diagnosis in English. – Osmundaceae.
- Leptopteris wilkesiana* (Brack.) G., Garden (London) 5: 414. 16 May 1874, based on *Todea wilkesiana* Brack., U.S. Expl., Filic. 16: 309, t. 43. 1854. – Osmundaceae. NOTE: Although the basonym is not mentioned, Art. 33.3 applies.
- Libonia* × *penrhosiensis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 5. 1 Apr 1871. Validated by a description in English. – Acanthaceae.
- Licuala kirsteniana* André, Rev. Hort. 67: 249. 1 Jun 1895. Validated by a diagnosis in French. – Arecaceae.

- Ligustrum coriaceum* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 48. 1 Apr 1871. Validated by a diagnosis in English. – Oleaceae.
- Lilium takesima* Morren, J. Soc. Natl. Hort. France, sér. 1, 7: 460. Jul 1861. Validated by a description in French. – Liliaceae.
- Livistonia moluccana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 215. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Macrozamia cylindrica* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Zamiaceae.
- Macrozamia plumosa* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Zamiaceae.
- Malortia intermedia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 215. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Malortia lacerata* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 126. 1 Apr 1871. Validated by a description in English. – Arecaceae.
- Maranta chimboracensis* Linden, Cat. Pl. Exot. 22/23: 6. Jan-Jun 1869. Validated by a diagnosis in French. – Marantaceae.
- Maranta concinna* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874. Validated by a description in English. – Marantaceae. NOTE: *Calathea leopardina* (Bull) Regel in Gartenfl. 26: 35. 1877, based on *M. leopardina* W.Bull in Country Gentleman's Magazine 3: 796, f. 5. Oct 1875, is not legitimate being a superfluous name because Regel cited *M. concinna* in synonymy. Presently, *C. leopardina* is widely accepted so that a conservation proposal is necessary.
- Maranta tubispatha* Linden, Supp. Extrait Cat. Gén. 82/24: 9. 1 Jul 1869. Validated by a diagnosis in French. – Marantaceae.
- Martinezia granatensis* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Arecaceae.
- Masdevallia harryana* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872. Validated by a diagnosis in English. – Orchidaceae.
- Masdevallia ignea* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872. Validated by a diagnosis in English. – Orchidaceae.
- Miconia peruviana* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 5. Aug 1868. Validated by a diagnosis in German. – Melastomataceae.
- Mormodes citrina* B.S.Williams, Orch. Grow. Man., ed. 2, 120. Oct 1862, as "*citrimum*." Validated by a description in English. – Orchidaceae.
- Narcissus albicans* (Haw.) Link, Handuch 1: 205. 4-11 Jul 1829, *nom. illeg.*, non Spreng. (1825), based on *Corbularia albicans* Haw., Syn. Pl. Succ. 332. 1812. – Amaryllidaceae. NOTE: The earlier Sprengel name (*N. albicans* Haw. ex Spreng., Syst. Veg., ed. 16, 2: 45. Jan-Mai 1825) is not legitimate as both *N. obesus* Salisb. (1796) and *N. inflatus* Haw. (1800) are cited in synonymy.
- Narcissus canariensis* J.C.Niven, Garden (London) 7: 11. 2 Jan 1875. Validated by a description in English. – Amaryllidaceae.
- Narcissus floribundus* (Haw.) Link, Handuch 1: 202. 4-11 Jul 1829, based on *Hermione floribunda* Salisb. ex Haw., Suppl. Pl. Succ. 141. Mai 1819. – Amaryllidaceae.
- Narcissus spurius* (Haw.) Link, Handuch 1: 204. 4-11 Jul 1829, based on *Ajax spurius* Haw., Syn. Pl. Succ. 327. 1812. – Amaryllidaceae.
- Nenga pumila* H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 218. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Odontoglossum maxillare* J.B.Norman, Gard. Chron., n.s., 2: 309. 5 Sep 1974, *nom. illeg.*, non Lindl. (1847). Validated by a brief description in English ("lip white with yellow base, petals and sepals white blotched at the base with brown"). – Orchidaceae. NOTE: This appears to be the same plant later described by J.D. Hooker in 1875 as *O. maxillare* Hook.f., Bot. Mag. 101: ad t. 6144. 1875, *nom. illeg.*

- Odontoglossum roezlii* W.Bull, Garden (London) 4: 20 Sep 1873. Validated by a brief description in English. – Orchidaceae.
- Osmanthus rotundifolius* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 51. 1 Apr 1871. Validated by a description in English. – Oleaceae.
- Palicourea discolor* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 5. Aug 1868. Validated by a diagnosis in German. – Rubiaceae.
- Pandanus ceramensis* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872. Validated by a diagnosis in English. – Pandanaceae.
- Pandanus gramineus* (Blume) H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 22. Aug 1868, based on *Freycinetia graminea* Blume, Rumphia 1: 159. 1837. – Pandanaceae.
- Pandanus inneri* Schaedtler, Hamburger Garten-Blumenzeitung 31: 298. Jul 1875. Validated by a diagnosis in German. – Pandanaceae.
- Passiflora macrocarpa* Linden, Cat. Pl. Exot. 22/23: 27. Jan-Jun 1869. Validated by a diagnosis in French. – Passifloraceae.
- Peperomia verschaffeltii* Linden, Suppl. Extrait Cat. Gén. 82/24: 10. 1 Jul 1869, as “*verschaffeltii*.” Validated by a diagnosis in French. – Piperaceae. NOTE: *Peperomia verschaffeltii* Lem. (Ill. Hort. 16: ad t. 598. Jul 1869) was apparently published after 1 July.
- Persicaria alata* (Buch.-Ham. ex D.Don) Nakai, Rept. Veg. Ooryongto 18. 1919, based on *Polygonum alatum* Buch.-Ham. ex D.Don, Prodr. Fl. Nepal. 72. 26 Jan-1 Feb 1825. – Polygonaceae.
- Persicaria filiformis* (Thunb.) Nakai, Rept. Veg. Ooryongto 18. 1919, based on *Polygonum filiforme* Thunb. in J.A.Murray, Syst. Veg., ed. 14, 377. Mai-Jun 1784. – Polygonaceae.
- Persicaria posumbu* (Buch.-Ham. ex D.Don) H.Gross in Engl. Bot. Jahrb. Syst. 49: 313. 1913, based on *Polygonum posumbu* Buch.-Ham. ex D.Don, Proc. Fl. Nepal. 71: 26 Jan-1 Feb 1825. – Polygonaceae.
- Phalaenopsis lobbii* (Rchb.f.) B.S.Williams, Orch. Grow. Man., ed. 2, 136. Oct 1862, based on *Phalaenopsis parishii* Rchb.f., var. *lobbii* Rchb.f., Refug. Bot. 2: ad t. 85. Jun 1869. – Orchidaceae. NOTE: The above combination is based on provisions in Art. 33.3.
- Philodendron devansayamum* André, Rev. Hort. 67: 250. 1 Jun 1895. Validated by a brief description in French. – Araceae.
- Phylogeny of authors, see Phylogeny above; for a list of species, see below.
- Phlox nelsonii* G.W.Johnson & Hogg, J. Hort. Cottage Gard., n.s., 28: 366. 13 Mai 1875. Validated by a diagnosis in English. – Polemoniaceae. NOTE: See also H.Jäger, Gartenflora 24: 270-271. 15 Sep 1875, as “*Nelsonii*.”
- Phoenix hanceana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 218. Mai 1875. Validated by a diagnosis in German. – Arecaceae.
- Phorinum atropurpureum* Rafarin, Rev. Hort. 46: 75. 16 Feb 1874. Validated by a description in French. – Xanthorrhoeaceae.
- Phyllanthus niveosus* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Euphorbiaceae.
- Phyllotaenium mirabile* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874. Validated by a description in English. – Araceae.
- Phylogyne heminalis* Haw., Suppl. Pl. Succ. 136. Mai 1819. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Phylogyne interjecta* Haw., Suppl. Pl. Succ. 135. Mai 1819. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Phylogyne minor* Haw., Suppl. Pl. Succ. 137. Mai 1819. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Phylogyne odora* (L.) Haw., Suppl. Pl. Succ. 134. Mai 1819, based on *Narcissus odorus* L., Cent. Pl. 2: 14. 2 Jun 1756. – Amaryllidaceae.

- Phylogyne rugulosa* Haw., Suppl. Pl. Succ. 133. Mai 1819. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Phylogyne triloba* (L.) Haw., Suppl. Pl. Succ. 135. Mai 1819, based on *Narcissus trilobus* L., Sp. Pl., ed. 2, 1: 417. Sep 1762. – Amaryllidaceae.
- Picea parsoniana* E.Manning, Gard. Monthly Hort. 10: 109. Apr 1868. Validated by a brief diagnosis in English ("of less glaucous hue" when compared to *P. amabilis*). – Pinaceae. NOTE: Possibly an orthographic variant of *P. parsonii* Gordon (Pinetum Suppl. 52. 1862).
- Pilocereus dautwitzii* J.N.Haage, Gard. Chron. 1873: 7. 4 Jan 1873. Validated by a description in English. – Cactaceae.
- Pilocereus hoppenstedtii* Haage & Schmidt, Pfl.-Cat. 1874: 5. Jan 1874, as "*hoppenstedtii*". Validated by a diagnosis in German. – Cactaceae.
- Pinus hookeriana* (A.Murray) W.R.McNab, Gard. Chron., n.s., 4: 711. 4 Dec 1875, based on *Abies hookeriana* A.Murray, Edinb. N. Philos. J., n.s., 1: 289. Jan-Apr 1855. – Pinaceae.
- Pinus pattonii* A.Murray, Phytologist 4: 1140. Dec 1853. Validated by a description in English. – Pinaceae. NOTE: No doubt this name alludes to the same species known as *Abies pattoniana* A.Murray, Rep. Bot. Exped. Oregon 1, pl. 4, fig. 2. 1853. As such either the Pytologist name is new (being published after the Circular) or is a correctable orthography and as such would be *Pinus pattoniana* (A.Murray) A.Murray, and thus predate *P. pattoniana* (A.Murray) Parl., Prodr. 16: 429. 1868. The McNab record in IPNI is a later place of publication for the name that was validly proposed first in Gard. Chron., n.s., 4: 711. 4 Dec 1875.
- Pinus sieboldii* A.Murray, Phytologist 4: 1140. Dec 1853, *nom. illeg.*, a new name for *P. tsuga* (Siebold & Zucc.) Antoine, Conf. 83, t. 32, f. 2. 1846, itself based on *Abies tsuga* Siebold & Zucc., Fl. Jap. 2: 14, t. 106. 1842. – Pinaceae.
- Pitcairnia floccosa* Regel, Gartenflora 23: 307. Oct 1874, based on *Pourretia floccosa* K. Koch, Wochenschr. 3: 251. 1860, *nom. illeg.*, non Linden (1853), and also Validated by a description in Latin. – Bromeliaceae.
- Plectocomya hystrix* Schaedtler, Hamburger Garten-Blumenzeitung 31: 251. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Polyanthus* Comstock, Intr. Stud. Bot. 122. 1832, *nom. illeg. et orth. var.* (≡ *Poltianthes* L., 1753). Validated by a description in English. – Amaryllidaceae. NOTE: No species was assigned to the genus by Comstock but the common name "Tuberose" was used which means his generic name is an orthographic variant of *Poltianthes* L. (1753).
- Pourretia yuccoides* Linden, Supp. Extrait Cat. Gén. 82/24: 12. 1 Jul 1869. Validated by a diagnosis in French. – Bromeliaceae.
- Pritchardia filifera* Rafarin, Rev. Hort. 46: 76. 16 Feb 1874. Validated by a description in French. – Arecaceae.
- Pritchardia grandis* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874. Validated by a description in English. – Arecaceae.
- Queltia galanthifolia* Haw., Syn. Pl. Succ. 328. 1812. Validated by a diagnosis and a description in Latin. – Amaryllidaceae.
- Quercus afghanistanensis* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873. Validated by a brief description in English. – Fagaceae.
- Quercus concordia* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873. Validated by a brief description in English. – Fagaceae.
- Quercus pectinata* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873. Validated by a brief description in English. – Fagaceae.
- Raphiolepis ovata* Rob., J. Hort. Cottage Gard. 6: 378. 24 Mai 1864. Validated by a brief description in English ("...evergreen, with dark ovate leaves...spikes of white flowers with pink stamens...shrub..."). – Rosaceae.
- Raphiolepis ovata* Veitch, Proc. Roy. Hort. Soc. 4:133. Jul 1864, *nom. illeg.*, non Rob. (1864). Validated by a description in English. – Rosaceae.

- Ricinus gibsonii* Veitch, Gard. Chron., n.s., 2: 610. 14 Nov 1874. Validated by a description in English. – Euphorbiaceae.
- Rosa affinis* Sternb., Flora 9(1, Beil.): 80. Apr-Mai 1826, *nom. illeg.*, non A.Rau (1815). Validated by a description in Latin. – Rosaceae.
- Rosa amblyotis* C.A.Mey., Zimmertosen 30. 1847. Validated by a description in Latin. – Rosaceae.
- Rosa anglica* Rösig, Oekon.-Bot. Rosen 59. 1799. Validated by description in German. – Rosaceae.
- Rosa belladonna* Andrews, Roses 1: 16. 1806, as “*Bella Donna*.” Validated by diagnoses in Latin and English. – Rosaceae.
- Rosa carnea* Dum.-Cours., Bot. Cult. 3: 348. 1-4 Jul 1802. Validated by a description in French. – Rosaceae.
- Rosa casta* Tratt., Rosac. Monogr. 2: 126. Jul-Dec 1823. Validated by a diagnosis and description in Latin. – Rosaceae.
- Rosa cinerea* Rösig, Oekon.-Bot. Rosen 2: 21. 1803. Validated by descriptions in German and Latin. – Rosaceae.
- Rosa dumalis* Bechst., Forstbot. 241, 969. 1810. Validated by a diagnosis and a description in German. – Rosaceae.
- Rosa fimbriata* Rösig, Oekon.-Bot. Beschr. Rosen 2: 60. 1803. Validated by descriptions in German and Latin. – Rosaceae.
- Rosa glauca* Bechst., Forstbot., ed. 4, 157, 605. 1821. Validated by a diagnosis and a description in German. – Rosaceae.
- Rosa humilis* Besser, Cat. Jard. Bot. Krzemieniec 117. 1811, *nom. illeg.*, based on *R. carolina* L., Sp. Pl. 1: 492. 1 Mai 1753. – Rosaceae.
- Rosa intermedia* Bosc, Nouv. Agric. Dict. Rais. Agric. 11: 262. 1809. Validated by a description in French. – Rosaceae.
- Rosa massiliensis* Breiter, Hort. Breiter 425. Jan-Oct 1817. Validated by a diagnosis in German by Wrede, Verz. Ros. 22. 1814. – Rosaceae.
- Rosa miniata* Breiter, Hort. Breiter 425. Jan-Oct 1817. Validated by a diagnosis in German by Wrede, Verz. Ros. 10. 1814. – Rosaceae.
- Rosa monophylla* Dum.-Cours., Bot. Cult. 3: 351. 1-4 Jul 1802. Validated by a description in French. – Rosaceae. NOTE: The author lists two names, one after the other: “*R. monophylla*. *R. simplicifolia*” with no indication of an author for the latter or an indication if the one name is an alternative name. However, if this refers to *R. simplicifolia* Salisb. (Prodr. Stirp. Chap. Allerton 359. 1796), a validly published name, then the Dumont de Courset name is not legitimate as it would be superfluous when published.
- Rosa monstrosa* Breiter, Hort. Breiter 425. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 10. 1814. – Rosaceae.
- Rosa montana* Steven ex Tratt., Rosac. Monogr. 2: xix. Jul-Dec 1823, *nom. illeg.*, non Chaix (1786). Validated by a description in Latin. – Rosaceae.
- Rosa nana* Rösig, Oekon.-Bot. Rosen 2: 39. 1803. Validated by descriptions in German and Latin. – Rosaceae.
- Rosa parisiensis* Rösig, Oekon.-Bot. Rosen 1: 60. 1799. Validated by a diagnosis in German. – Rosaceae.
- Rosa picta* Breiter, Hort. Breiter 427. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 23. 1814. – Rosaceae.
- Rosa podolica* Tratt., Rosac. Monogr. 2: 71. Aug-Dec 1823, based on *R. glaucescens* Besser, Enum. Pl. 19. 1822, *nom. illeg.*, non Wulfen (1805). – Rosaceae. NOTE: The name was also associated with a diagnosis and a description in Latin.
- Rosa pomponia* Rösig, Oekon.-Bot. Beschr. Rosen 2: 53. 1803. Validated by descriptions in German and Latin. – Rosaceae.
- Rosa prolifera* Breiter, Hort. Breiter 427. Jan-Oct 1817. Validated by a diagnosis in German. – Rosaceae.

- Rosa purpurea* Breiter, Hort. Breiter 428. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 24. 1814. – Rosaceae.
- Rosa redutea* Thory, Rosa Redutea 3. 20 Dec 1817. Validated by a description in Latin. – Rosaceae. NOTE: It is likely that *R. reduteana* Thory ex Red. (Roses 1: 101. 16 Mai 1818), currently cited by IPNI, is an orthographic variant.
- Rosa resinosa* Sternb., Flora 9(1, Beil.): 76. Apr-Mai 1826. Validated by a description in Latin. – Rosaceae.
- Rosa rotundifolia* (A.Rau) Tratt., Rosac. Monogr. 2: 73. Aug-Dec 1823, based on *R. rubiginosa* var. *rotundifolia* A.Rau, Enum. Ros. Wirceb. 136. Mar-Dec 1815. – Rosaceae. The combination was also associated with a diagnosis and a description in Latin.
- Rosa rubicans* Breiter, Hort. Breiter 429. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 34. 1814. – Rosaceae.
- Rosa sorbifolia* Breiter, Hort. Breiter 431. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 32. 1814. – Rosaceae.
- Rosa spherica* Gren. ex Ardoine, Fl. Anal. Alpes-Mar. 127. 1867. Validated by a description in French. – Rosaceae.
- Rosa swartziana* Fr., Novit. Fl. Svec. 34. 11 Mai 1814. Validated by a description in Latin. – Rosaceae.
- Rosa tricolor* Breiter, Hort. Breiter 431. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 28. 1814. – Rosaceae.
- Rosa unica* Bosc, Nouv. Nouv. Agric. Dict. Rais. Agric. 11: 259. 1809. Validated by a description in French. – Rosaceae.
- Rosa venosa* Steven ex Tratt., Rosac. Monogr. 2: xv. Jul-Dec 1823. Validated by a description in Latin. – Rosaceae.
- Rosa vilmorina* Breiter, Hort. Breiter 433. Jan-Oct 1817. Validated by a diagnosis in German and a diagnosis in German by Wrede, Verz. Ros. 6. 1814. – Rosaceae.
- Rosa viscida* Raf., Kentucky Gaz. 1(32): 3. 8 Aug 1822. Validated by a description in English. – Rosaceae.
- Sabal nobilis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 254. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Saccolabnum furcatum* B.S. Williams, Orch. Grow. Man., ed. 2, 141. Oct 1862. Validated by a description in English. – Orchidaceae.
- Salacca wagneri* Schaedtler, Hamburger Garten-Blumenzeitung 31: 257. Jun 1875, as “*Zalacca Wagneri*.” Validated by a diagnosis in German. – Arecaceae.
- Saribus hogendorpii* Zoll. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875. Validated by a diagnosis in German. – Arecaceae. NOTE: The later *S. hoogendorpii* Kuntze (Revis. Gen. 2: 736. 1891) is almost certainly an orthographic variant. If the plant was named for Count Ghisbert Karl van Hogendorp (1762–1834) or his brother Count Dirk van Hogendorp (1761–1830), or a relative, then the orthography in Schaedtler would be correct.
- Sarracenia* × *stevensii* Rob., Garden (London) 5: 494. 6 Jun 1874 (*S. purpurea* × *S. flava*). Validated by a diagnosis in English. – Sarracenaceae.
- Saurauia sarapigienensis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871. Validated by a description in English. – Actinidiaceae.
- Saxifraga bucklandii* Niven, Garden (London) 6: 4. 4 Jul 1874. Validated by a description in English. – Saxifragaceae.
- Sempervivum atlanticum* (Ball ex Hook.f.) Baker, Gard. Chron., n.s., 2: 104. 25 Jun 1874, based on *S. tectorum* var. *atlanticum* Ball ex Hook.f., Curtis's Bot. Mag., ser. 3, 29: ad t. 6055. 1 Sep 1873. – Crassulaceae.
- Sempervivum calcareum* Rob., Alpine Fl. Engl. Gard. 336. 1870, *nom. illeg.* Validated by a description in English. – Crassulaceae. NOTE: Although Robinson said this species was “probably” the same as *S. calcareum*, this does not render his name provisional as Robinson

- accepted *S. calcareum*. However, his name is not legitimate as he cited *S. californicum* (see below) in synonymy.
- Sempervivum californicum* K.Koch, Wochenschr. Vereines Beford. Gartenbaues Konigl. Preuss. Staaten 6: 167. 23 Mai 1863. Validated by a brief description in German ("Ein Sempervivum mit dem Namen californicum hatte Blätter mit braunen Spitzen"). Crassulaceae. NOTE: See also: G.W.Johnson & R.Hogg, J. Hort. Cottage Gard. 1867: 256. 3 Oct 1867. Validated by a brief description in English ("...tipped with brownish crimson..."), and D. Thomson, Handy Book Fl.-Gard. 245. 1868. Validated by a brief description in English ("...large dense green rosettes, each leaf being tipped with dark brown ... forming offsets..."). Each of these places of publication predate that given currently in IPNI.
- Smilacina oligophylla* Baker ex Elwes, Garden (London) 6: 191. 29 Aug 1874. Validated by a diagnosis in English. – Asparagaceae.
- Sonerila hendersonii* E.G.Hend., Garden (London) 6: 63. 18 Jul 1874. Validated by a diagnosis in English. – Melastomataceae. NOTE: The name was published on the same day: Gard. Chron., n.s., 2: 83. 18 Jul 1874, validated by a diagnosis in English.
- Spathiphyllum pictum* W.Bull, Gard. Chron., n.s., 2: 160. 8 Aug 1874. Validated by a description in English. – Araceae.
- Starkea odoratissima* Haage & Schmidt, Pfl.-Cat. 1874: 6. Jan 1874. Validated by a diagnosis in German. – Asteraceae.
- Sternbergia clusiana* Sweet, Hort. Brit. 401. Sep-Oct 1826. Validated by a reference to a pre-Linnaean diagnosis by Clusius in Latin. – Amaryllidaceae.
- Sternbergia lutea* (L.) Sweet, Hort. Brit. 401. Sep-Oct 1826, based on *Amaryllis lutea* L., Sp. Pl. 1: 292. 1 Mai 1753. – Amaryllidaceae.
- Streptocarpus* × *greenei* Green, Gard. Chron., n.s., 4: 180. 7 Aug 1875 (*S. saundersii* × *S. rexi*). Validated by a diagnosis in English. – Gesneriaceae.
- Thrinax graminifolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 257. Jun 1875. Validated by a diagnosis in German. – Arecaceae.
- Thuja sempercaurea* Hort., Gard. Chron., n.s., 2: 303. 5 Sep 1874. Validated by a diagnosis in English. – Cupressaceae.
- Tillandsia lindenii* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 6. Aug 1868, as "*Lindenii*." Validated by a diagnosis in German. – Bromeliaceae.
- Tillandsia mosaic* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874. Validated by a description in French. – Bromeliaceae.
- Tillandsia roezlii* Linden ex Ortgies, Gartenflora 23: 47. Jan 1874. Validated by a description in German. – Bromeliaceae.
- Torreya bogotensis* Linden, Suppl. Extrait Cat. Gén. 82/24: 10. 1 Jul 1869. Validated by a diagnosis in French. – Taxaceae.
- Tritoma caulescens* (Baker) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia caulescens* Baker, Bot. Mag. 98: ad t. 5946. 1872. – Xanthorrhoeaceae.
- Tritoma macowanii* Rob., Garden (London) 6: 262. 19 Sep 1874, as "*MacOwani*." Validated by a diagnosis in English ("blooms are of a paler colour than those of ... *T. Uvaria*." – Xanthorrhoeaceae. NOTE: No reference is made to the earlier *Kniphofia macowanii* Baker, J. Bot. 12: 3. 1874, but as *Tritoma*, a subdivision of *Kniphofia*, was mentioned by Baker, one could consider the Robinson name to be a new combination via Art. 33.3 rather than a new species as indicated here.
- Tritoma sarmentosa* (Kunth) W.Mast., Garden (London) 5: 500. 13 Jun 1874, based on *Kniphofia sarmentosa* Kunth, Enum. Pl. 4: 552. 23-29 Mai 1841. – Xanthorrhoeaceae.
- Vriesea reticulata* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873. Validated by a description in English. – Bromeliaceae.
- Zamia fusca* Schaedtler, Hamburger Garten-Blumenzeitung 31: 307. Jul 1875. Validated by a diagnosis in German. – Zamiaceae.



*Zamia wallisii* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875. Validated by a description in English.  
– *Zamiaceae*. NOTE: The authorship given currently by IPNI for a slightly later name should be corrected to Veitch ex A. Braun.

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### *Acanthaceae* Juss.

*Chamaeranthemum reticulatum* W.Bull, Proc. Roy. Hort. Soc. 4: 73. Apr 1864.  
*Eranthemum aureoreticulatum* Veitch, Garden (London) 5: 276. 28 Mar 1874.  
*Eranthemum rubronennum* Veitch, Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863.  
*Fittonia gigantea* Linden, Cat. Pl. Exot. 22/23: 5. Jan-Jun 1869.  
*Justicia hutea* Loisel., Herb. Gén. Amateur 6: ad t. 403. 1822.  
*Libonia* × *penrhosiensis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 5. 1 Apr 1871.  
*Ruellia pitcairniifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 41. 1871.

### *Actinidiaceae* Engl. & Gilg.

*Saurauia sarapigensis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871.  
*Saurauia superba* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 5. Aug 1868.

### *Adiantaceae* Newman

*Adiantum elegantissimum* B.S.Williams ex R.Hogg, Florist & Pomol. 27: 135. Jun 1874.  
*Adiantum gracillimum* B.S.Williams ex R.Hogg, Florist & Pomol. 27: 42. Feb 1874.  
*Adiantum hendersonii* E.C.Hend., Gard. Chron. 1873: 570. 26 Apr 1873.  
*Adiantum jarlegense* C.Loury, Rev. Hort. 47: unpag. 16 Jul 1875.  
*Adiantum zahnii* Veitch, Florist & Pomol. 27: 158. Jul 1874.

### *Alstroemeriaceae* Dumort.

*Alstroemeria bredemeyerana* Willd. ex Schult. & Schult.f., Syst. Veg. 7(1): 751. 1829.

### *Amaranthaceae* Juss.

*Acnida rhyssocarpa* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 384. 1834, *nom. illeg.*  
*Amaranthus chlororuber* Haage & Schmidt, Haupt-Verz. Samen 1875: 6. Jan 1875.  
*Amaranthus* × *henderi* Hurst, Gard. Chron., n.s., 2: 738. 12 Dec 1874.  
*Amaranthus henderi* W.Hend., Gard. Chron., n.s., 2: 770. 19 Dec 1874, *nom. illeg.*  
*Amaranthus hendersonii* Hort., Vick's Ill. Mag. 1: 354. Dec 1878, *nom. illeg.*  
*Amaranthus hendersonii* J.Weber, J. Hort. Cottage Gard. 27: 304. 1 Oct 1874.  
*Amaranthus salignus* Carrière, Rev. Hort. 46: 80. 16 Feb 1874.  
*Iresine aureoreticulata* J.Saul, Gard. Monthly Hort. 10: 64 [Hort. Advert. 48]. Feb 1868.

### *Amaryllidaceae* J.St.-Hil.

*Ajax cermaus* Haw., Philos. Mag., n.s., 8: 131. Aug 1830.  
*Ajax lorifolius* Haw., Suppl. Pl. Succ. 119. Mai 1819.  
*Ajax minor* (L.) Haw., Suppl. Pl. Succ. 112. Mai 1819.  
*Ajax moschatus* (L.) Haw., Suppl. Pl. Succ. 118. Mai 1819.  
*Ajax namus* Haw. in R. Sweet, Brit. Fl. Gard., ser. 2. 25(App.): 2. 1 Jun 1831.  
*Ajax propinquus* (Salisb.) Haw., Suppl. Pl. Succ. 116. Mai 1819.  
*Ajax serratus* (Haw.) Haw., Suppl. Pl. Succ. 114. Mai 1819.  
*Ajax tortuosus* (Haw.) Haw., Philos. Mag., n.s., 8: 131. Aug 1830.  
*Amaryllis caplyprata* Ker Gawl., Bot. Reg. 2: ad t. 164. 1 Jan 1817.

- Amaryllis citrina* Sibth. & Sm., Fl. Graec. Prodr. 1: 221. Mai-Nov 1809.  
*Amaryllis chusiana* Ker Gawl., Curtis's Bot. Mag. 27: ad t. 1089. 1 Mar 1808.  
*Amaryllis colchiciflora* (Waldst. & Kit.) Ker Gawl., Curtis's Bot. Mag. 27: ad t. 1089. 1 Mar 1808.  
*Amaryllis grandiflora* (Lindl.) Herb., Amaryllidaceae 278. late Apr 1837.  
*Amaryllis hybrida* Neubert, Deutsch. Mag. 32: 333. 1879.  
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*Amaryllis tettaui* Haage & Schmidt, Pfl.-Cat. 1874: 1. Jan 1874.  
*Amaryllis virginialis* B.S. Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874.  
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*Chloraster integer* Haw., Philos. Mag. J. 63: 104. Feb 1824.  
*Cooperia drummondiana* Herb., Amaryllidaceae 178. late Apr 1837, *nom. illeg.*  
*Corbularia albicans* Haw., Syn. Pl. Succ. 332. 1812.  
*Crimum* × *lousiae* Herb., Amaryllidaceae 274. late Apr 1837.  
*Crimum* × *gowentianum* Herb., Trans. Hort. Soc. London 3: 190-191, fig. Jan-Feb 1820.  
*Crimum alboense* Herb., Amaryllidaceae 272. late Apr 1837.  
*Crimum anomalum* Herb., Curtis's Bot. Mag. 47: ad t. 2121. 1 Jan 1820.  
*Crimum brevifolium* Herb., Curtis's Bot. Mag. 47: ad t. 2121. 1 Jan 1820, *nom. illeg.*  
*Crimum macrocarpon* Herb., Curtis's Bot. Mag. 47: ad t. 2121. 1 Jan 1820.  
*Crimum makoyanum* E.C. Hend., Gard. Chron. 1873: 534. 19 Apr 1873.  
*Crimum procerum* Herb., Curtis's Bot. Mag. 47: ad t. 2121. 1 Jan 1820.  
*Crimum venustum* Carey ex Herb., Appendix 22. late Dec 1821.  
*Crimum verecundum* Carey ex Herb., Appendix 22. late Dec 1821.  
*Doryanthes palmeri* W. Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Erinosma vernum* (L.) Herb., Amaryllidaceae 331. late Apr 1837.  
*Eucharis amazonica* R. Hogg, Florist Fruitist Gard. Misc. 1856: 228. Aug 1856.  
*Habranthus robustus* Herb. in R. Sweet, Brit. Fl. Gard. ser. 2. 1: ad t. 14. 1 Sep 1829.  
*Haemanthus cooperi* E.G. Hend., Garden (London) 5: 430. 16 Mai 1874.  
*Hermione jasminea* Salisb. ex Haw., Philos. Mag., n.s., 8: 133. Aug 1830.  
*Hermione lacticolor* Haw. in R. Sweet, Brit. Fl. Gard., ser. 2. 25(App.): 10. 1 Jun 1831.  
*Hermione* Salisb. ex Haw., Suppl. Pl. Succ. 137. Mai 1819.  
*Hippeastrum ambiguum* Herb., Curtis's Bot. Mag., n.s. 11: ad t. 3542. 1 Jan 1837.  
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*Hippeastrum oriflamme* B.S. Williams, Florist & Pomol. 27: 116. Mai 1874.  
*Hippeastrum picturatum* W. Bull, Garden (London) 5: 176. 28 Feb 1874.  
*Hippeastrum striatifolium* (Herb.) Herb., Appendix 34. Dec 1821.  
*Hymenocalyx undulata* (Kunth) Houlet, Rev. Hort. 1869: 418. 1 Nov 1869.  
*Imantophyllum barkeri* C.J. Barker, Gard. Chron., n.s., 1: 317. 7 Mar 1874.  
*Jonquilla odora* Raf., Fl. Tellur. 4: 20-21. mid 1838.  
*Narcissus albicans* (Haw.) Link, Handuch 1: 205. 4-11 Jul 1829, *nom. illeg.*  
*Narcissus canariensis* J.C. Niven, Garden (London) 7: 11. 2 Jan 1875.  
*Narcissus floribundus* (Haw.) Link, Handuch 1: 202. 4-11 Jul 1829.  
*Narcissus spurnus* (Haw.) Link, Handuch 1: 204. 4-11 Jul 1829.  
*Nerine* × *mitchamiae* Herb., Amaryllidaceae 283, 286, t. 43. late Apr 1837.  
*Nerine amabilis* Tubergen, Wholesale Cat. Flowerroots 28. 1892.  
*Pancratium notatum* W. Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 28. 1 Apr 1871.  
*Phylogyne heminalis* Haw., Suppl. Pl. Succ. 136. Mai 1819.  
*Phylogyne interjecta* Haw., Suppl. Pl. Succ. 135. Mai 1819.  
*Phylogyne minor* Haw., Suppl. Pl. Succ. 137. Mai 1819.  
*Phylogyne odora* (L.) Haw., Suppl. Pl. Succ. 134. Mai 1819.  
*Phylogyne rugulosa* Haw., Suppl. Pl. Succ. 133. Mai 1819.  
*Phylogyne* Salisb. ex Haw., Suppl. Pl. Succ. 132. Mai 1819.

*Phylogyne triloba* (L.) Haw., Suppl. Pl. Succ. 135. Mai 1819.  
*Polianthes purpureus* R.Dean, Garden, 5: 298. 4 Apr 1874.  
*Polyanthus* Comstock, Intr. Stud. Bot. 122. 1832, *nom. illeg. et orth. var.*  
*Queltia galanthifolia* Haw., Syn. Pl. Succ. 328. 1812.  
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#### Anacardiaceae R. Br.

*Spondias olivaeformis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 31. 1 Apr 1871.

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*Anemia plumbea* Makoy ex E.Morren, Belg. Hort. 25: 200. 1875.  
*Anemia tessellata* Makoy ex E.Morren, Belg. Hort. 25: 200. 1875.  
*Anguloa mantinii* André, Rev. Hort. 67: 249. 1 Jun 1895.

#### Apiaceae Lindl.

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*Heracleum leichtlinii* Haage & Schmidt, Pl. Cat. 36. Jan 1870.

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*Dipladenia × williamsii* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874.  
*Dipladenia bearelyana* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874.  
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*Alocasia gibsonii* E.C.Hend., Gard. Chron. 1873: 604. 3 Mai 1873.  
*Alocasia × hybrida* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 17. 1 Apr 1871.  
*Alocasia × intermedia* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 2. Aug 1868.  
*Alocasia illustris* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Alocasia plumbea* van Houtte, Fl. Serres 21: 93. 1 Oct 1875, *nom. illeg.*  
*Caladium lilliputianum* André, Rev. Hort. 67: 250. 1 Jun 1895.  
*Calamus dealbatus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 123. 1 Apr 1871.  
*Calamus nicolai* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875.  
*Calamus obovoides* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875.  
*Dieffenbachia antioquiensis* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Dieffenbachia baraquimiana* W.Bull, Proc. Roy. Hort. Soc. 4:133. Jul 1864, *nom. illeg.*  
*Dieffenbachia eburnea* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 22. 1 Apr 1871.  
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*Dieffenbachia grandis* W.Bull, Proc. Roy. Hort. Soc. 4:133. Jul 1864.  
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*Dieffenbachia parlatoresii* Hort., Gard. Chron., n.s., 1: 665. 23 May 1874.  
*Dieffenbachia pearcei* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868.  
*Dieffenbachia verschaffeltii* Hort., Proc. Roy. Hort. Soc. 3:280. 29 Mai 1863.  
*Dieffenbachia wallisii* Linden, Cat. Pl. Exot. 22/23: 4. Jan-Jun 1869.  
*Philodendron devansayamun* André, Rev. Hort. 67: 250. 1 Jun 1895.  
*Philodendron parmensense* Linden ex Regel, Gartenflora 24: 175. 15 Jun 1875.  
*Phyllotaenium mirabile* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874.

- Pothos endressii* Veitch, Gard. Chron., n.s., 4: 294. 4 Sep 1875.  
*Spathiphyllum macrophyllum* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Spathiphyllum pictum* W.Bull., Gard. Chron., n.s., 2: 160. 8 Aug 1874.

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- Aralia granatensis* W.Bull., Gard. Chron., n.s., 1: 532. 25 Apr 1874.  
*Aralia guilfoylei* W.Bull., Gard. Chron. 1873: 606. 3 Mai 1873.  
*Aralia laciniata* Rafarin, Rev. Hort. (Paris) 49: 326. 1 Sep 1877.  
*Aralia sieboldii* T.Meehan, Gard. Monthly Hort. 10: 24. Jan 1868.  
*Aralia veitchii* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873.

#### **Araucariaceae Henkel & W.Hochst.**

- Araucaria neocaledonica* Linden ex Regel, Gartenflora 24: 176. 15 Jun 1875.

#### **Arecaceae Bercht. & J.Presl**

- Acanthophoenix grandis* André, Rev. Hort. 67: 250. 1 Jun 1895.  
*Acanthorrhiza* Linden, Cat. Pl. Exot. 22/23: 47. Jan-Jun 1869.  
*Acanthorrhiza warszewiczii* Linden, Cat. Pl. Exot. 22/23: 47. Jan-Jun 1869  
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*Astrocaryum filare* W.Bull., Gard. Chron., n.s., 3: 491. 17 Apr 1875.  
*Bactris caravellana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris cucullata* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris diplothemum* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris martinicensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris obovata* H.Wendl. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Bactris spinosissima* Schaedtler, Hamburger Garten-Blumenzeitung 31: 67. Feb 1875.  
*Brahea filamentosa* H.Wendl., Rev. Hort. 47: unpag. 16 Aug 1875.  
*Brahea ghiesbreghtii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 68. Feb 1875.  
*Brahea lucida* Schaedtler, Hamburger Garten-Blumenzeitung 31: 69. Feb 1875.  
*Brahea nitida* Schaedtler, Hamburger Garten-Blumenzeitung 31: 69. Feb 1875.  
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*Calyptrigyne sarapiquensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 70. Feb 1875.  
*Caryota elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875.  
*Caryota majestica* Schaedtler, Hamburger Garten-Blumenzeitung 31: Mar 111. 1875.  
*Caryota tenuis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875.  
*Caryota verschaffeltii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 111. Mar 1875.  
*Ceroxylon ferrugineum* Devansaye, Rev. Hort. 46: 214. 1 Jun 1874.  
*Ceroxylon niveum* Hort., Gard. Chron., n.s., 1: 255. 21 Feb 1874.  
*Chamaedorea ahrenbergii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 113. Mar 1875.  
*Chamaedorea elegans* Schaedtler, Hamburger Garten-Blumenzeitung 31: 114. Mar 1875.  
*Chamaedorea ghiesbreghtii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 114. Mar 1875.  
*Chamaedorea hartwegii* B., Garden (London) 6: 368. 17 Oct 1874.  
*Chamaedorea obovoidea* Schaedtler, Hamburger Garten-Blumenzeitung 31: 155. Apr 1875.  
*Chamaedorea wendlandii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 156. Apr 1875.  
*Chamaerops arborea* Linden, Supp. Extrait Cat. Gén. 82/24: 26. 1 Jul 1869.  
*Chamaerops ghiesbreghtii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 157. Apr 1875.  
*Chamaerops major* Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. Apr 1875.  
*Chamaerops nivea* Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. Apr 1875.

- Chamaerops tenuifrons* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 158. Apr 1875.  
*Cheiranthus dillenianus* R. Dean, *Florist & Gard.* 28: 188. Aug 1875.  
*Cocos elegantissima* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 158. Apr 1875.  
*Colpothrix wrightii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875.  
*Copernicia barbadensis* (Lodd. ex Mart.) Devansaye, *Rev. Hort.* 47: 35. 16 Jan 1875.  
*Copernicia macroglossa* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875.  
*Copernicia robusta* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 160. Apr 1875.  
*Corypha glauca* Devansaye, *Rev. Hort.* 47: 32. 16 Jan 1875, *nom. illeg.*  
*Corypha martiana* Devansaye, *Rev. Hort.* 47: 32. 16 Jan 1875, *nom. illeg.*  
*Corypha robusta* Wendl. ex Devansaye, *Rev. Hort.* 47: 32. 16 Jan 1875, *nom. illeg.*  
*Daemonorops cinnamomeus* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 161. Apr 1875.  
*Daemonorops ornatus* W. Bull, *Gard. Chron.*, n.s., 3: 523. 24 Apr 1875.  
*Daemonorops oxleyanus* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 162. Apr 1875.  
*Deckertia nobilis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 162. Apr 1875.  
*Diglossophyllum serrulatum* (Michx.) H. Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 162. Apr 1875.  
*Eremospatha* Mann & H. Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 163. Apr 1875.  
*Eremospatha macrocarpa* Mann & H. Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 163. Apr 1875.  
*Euterpe antioquiensis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 163. Apr 1875, *nom. illeg.*  
*Euterpe decurrens* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 164. Apr 1875.  
*Euterpe zamora* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 164. Apr 1875.  
*Gaussia portoricensis* H. Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 164. Apr 1875.  
*Geonoma amazonica* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 164. Apr 1875.  
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*Geonoma helliana* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 166. Apr 1875.  
*Geonoma tenuifolia* André, *Rev. Hort.* 67: 250. 1 Jun 1895.  
*Geonoma verschaffeltii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 166. Apr 1875.  
*Geonoma wallisii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 166. Apr 1875.  
*Geonoma zamorensis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 166. Apr 1875.  
*Glaziova insignis* Rob., *Gard. Chron.*, n.s., 1: 665. 23 May 1874.  
*Hyophorbe madagascariensis* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 167. Apr 1875.  
*Hyospathe chiriqui* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 168. Apr 1875.  
*Iriartea gigantea* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 168. Apr 1875.  
*Kentia balmoreana* Rafarin, *Rev. Hort.* 46: 76. 16 Feb 1874.  
*Kentia moorei* W. Bull, *Garden* (London) 5: 493. 6 Jun 1874.  
*Latania glaucophylla* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 170. Apr 1875.  
*Latania jenkinsiana* (Griff.) Devansaye, *Rev. Hort.* 47: 34. 16 Jan 1875.  
*Latania olivaeformis* Devansaye, *Rev. Hort.* 47: 34. 16 Jan 1875.  
*Licuala kristeniana* André, *Rev. Hort.* 67: 249. 1 Jun 1895.  
*Licuala orleyi* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 214. Mai 1875.  
*Livistonia moluccana* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 215. Mai 1875.  
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*Malortia lacerata* W. Bull, *Retail List [Wholesale List New Beautiful Rare Pl. 60:]* 126. 1 Apr 1871.  
*Martinezia granatensis* W. Bull, *Gard. Chron.*, n.s., 1: 532. 25 Apr 1874.  
*Martinezia nobilis* W. Bull, *Garden* (London) 8: 77. 24 Jul 1875.  
*Morenia galeottiana* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 218. Mai 1875.  
*Morenia ruitzii* Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 218. Mai 1875.  
*Nenga pumila* H. Wendl. ex Schaedtler, *Hamburger Garten-Blumenzeitung* 31: 218. Mai 1875.

*Phoenix hanceana* Schaedtler, Hamburger Garten-Blumenzeitung 31: 218. Mai 1875.  
*Plectocomia andersonii* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Plectocomia hystrix* Schaedtler, Hamburger Garten-Blumenzeitung 31: 251. Jun 1875.  
*Pritchardia filifera* Rafarin, Rev. Hort. 46: 76. 16 Feb 1874.  
*Pritchardia grandis* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874.  
*Ptychosperma oliviformis* Schaedtler, Hamburger Garten-Blumenzeitung 31: Jun 252. 1875.  
*Sabal nobilis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 254. Jun 1875.  
*Sabal warszewiczii* Schaedtler, Hamburger Garten-Blumenzeitung 31: 254. Jun 1875.  
*Salacca wagneri* Schaedtler, Hamburger Garten-Blumenzeitung 31: 257. Jun 1875.  
*Saribus hogendorpii* Zoll. ex Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875.  
*Seaforthia alexandriae* Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875.  
*Seaforthia excelsa* Schaedtler, Hamburger Garten-Blumenzeitung 31: 255. Jun 1875.  
*Socratea affinis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875.  
*Socratea squitos* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875.  
*Stephanosia sechallana* (H.Wendl.) R.Hogg, Florist & Pomol. 133. Jun 1865.  
*Synechanthus gracilis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875.  
*Synechanthus sarapiquensis* Schaedtler, Hamburger Garten-Blumenzeitung 31: 256. Jun 1875.  
*Thrinax graminifolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 257. Jun 1875.  
*Wallichia oblongata* Regel, Gartenflora 24: 177. Jun 1875.

#### Aristolochiaceae Juss.

*Aristolochia elevata* Gera, Nuovo Diz. Univ. Agric. 5: 348. 1837.

#### Asparagaceae Juss.

*Agave bulbosa* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 3. 1 Apr 1871.  
*Agave gucaefolia* Mannetti in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 380. 1834.  
*Agave gustaviana* Haage & Schmidt, Pfl.-Cat. 1874: 1 Jan 1874.  
*Agave killischea* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Agave leopoldti* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Agave monstrosa* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Agave mooreana* Mast. & T.Moore, Gard. Chron., n. s., 1: 60. 10 Jan 1874.  
*Agave perringea* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Agave robusta* Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.  
*Anthericum variegatum* B.S.Williams, Gard. Chron., n.s., 3: 442. 3 Apr 1875.  
*Anthurium candidum* W.Bull, Gard. Chron., n.s., 3: 491. 17 Apr 1875.  
*Anthurium crystallinum* Th.Meehan, Gard. Chron., n.s., 1: 92. 17 Jan 1874.  
*Anthurium hybridum* B.S.Williams ex Rob., Garden (London) 5: 276. 28 Mar 1874.  
*Anthurium williamsii* Hort., Gardener 8: 198. Mai 1874.  
*Asparagus albanensis* André, Rev. Hort. 67: 249. 1 Jun 1895.  
*Beaucarnea tuberculata* (Hort. ex Lem.) Hurst, Gard. Chron., n.s., 2: 738. 12 Dec 1874.  
*Coelanthus amplificatus* Willd. ex Herb., Amaryllidaceae 86. late Apr 1837.  
*Cordylone banksii* J.Dix, Proc. Roy. Hort. Soc. 4: 133. Jul 1864, nom. illeg.  
*Cordylone kirkii* Haage & Schmidt, Haupt-Verz. Samen 1875: 4. Jan 1875.  
*Dracaena albicans* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 23. 1 Apr 1871.  
*Dracaena* × *albo-marginata* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena alborosea* W.Bull, Gard. Chron., n.s., 2: 160. 8 Aug 1874.  
*Dracaena* × *amalliae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *anerleyensis* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena angusta* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 23. 1 Apr 1871.  
*Dracaena* × *barronii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.

- Dracaena* × *bausei* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *bella* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *berkeleyi* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena candida* W.Bull, Gard. Chron., n.s., 3: 474. 10 Apr 1875.  
*Dracaena* × *cantrellii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *carolettiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena dennissonii* Veitch ex E.Morren, Belgique Hort. 22: 353. Dec 1872.  
*Dracaena dennissoniae* Veitch, Cat. New Beautiful Pl. 1873: 38. Jul-Aug 1873.  
*Dracaena duffii* E.G.Hend., Gard. Chron., n.s., 2: 722. 5 Dec 1874.  
*Dracaena* × *elizabethiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *ernestii* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena excelsa* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 23. 1 Apr 1871, nom. illeg.  
*Dracaena* × *extima* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena formosa* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena fraseri* Hort., Gard. Chron. 1873: 5. 4 Jan 1873.  
*Dracaena* × *fredericii* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *fulgens* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena gemma* W.Bull, Gard. Chron., n.s., 3: 557. 1 Mai 1875.  
*Dracaena glonerea* Linden ex Rafarin, Rev. Hort. 46: 75. 16 Feb 1874.  
*Dracaena gloriosa* Hort., Gard. Chron. 1873: 6. 4 Jan 1873.  
*Dracaena goldiana* Hort., Gard. Chron. 1873: 5. 4 Jan 1873.  
*Dracaena grandis* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena guilfoylei* Moore ex Linden, Supp. Extrait Cat. Gén. 82/24: 6. 1 Jul 1869.  
*Dracaena hendersonii* Veitch, Gard. Chron., n.s., 1: 531. 25 Apr 1874.  
*Dracaena* × *hybrida* W.Bull ex R.Hogg, Florist & Pomol. 27: 158. Jul 1874.  
*Dracaena illustris* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena* × *imperator* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena imperialis* Hort., Gard. Chron. 1873: 5. 4 Jan 1873.  
*Dracaena insignis* W.Bull, Gard. Chron., n.s., 3: 474. 10 Apr 1875.  
*Dracaena intermedia* E.C.Hend., Gard. Chron. 1873: 498. 12 Apr 1873.  
*Dracaena* × *jucunda* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *leucochila* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *mabiliae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena macleayi* Linden, Supp. Extrait Cat. Gén. 82/24: 7. 1 Jul 1869.  
*Dracaena magnifica* Veitch ex E.Morren, Belgique Hort. 22: 15. Jan 1872.  
*Dracaena* × *mastersii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena mooreana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871.  
*Dracaena moorei* Veitch ex E.Morren, Belgique Hort. 22: 354. Dec 1872.  
*Dracaena nigrorubra* Linden, Supp. Extrait Cat. Gén. 82/24: 7. 1 Jul 1869.  
*Dracaena nigrostriata* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena* × *pendens* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena picta* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena* × *picturata* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena porphyrophylla* E.Morren, Belgique Hort. 22: 354. Dec 1872.  
*Dracaena princeps* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.  
*Dracaena pulchella* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871.  
*Dracaena* × *rebeccaiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *renardiae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.

- Dracaena rex* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875.  
*Dracaena rubella* W.Bull., Gard. Chron., n.s., 3: 557. 1 Mai 1875.  
*Dracaena* × *salmonae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *scottiae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena shepherdii* Hort., Gard. Chron. 1873: 6. 4 Jan 1873.  
*Dracaena shepherdii* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874, *nom. illeg.*  
*Dracaena spectabilis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 24. 1 Apr 1871.  
*Dracaena splendens* W.Bull ex E.Morren, Belgique Hort. 22: 15. Jan 1872.  
*Dracaena striatifolia* E.C.Hend., Gard. Chron. 1873: 498. 12 Apr 1873.  
*Dracaena* × *sydneyi* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *taylori* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875.  
*Dracaena* × *tellingii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *thomiae* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena triumphans* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875.  
*Dracaena verschaaffeltii* Verschaff., Mag. Hort. Bot. 33: 187. Jun 1867.  
*Dracaena* × *vemusta* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *versicolor* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *victoriae* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena* × *violacea* T.Moore, Gard. Chron., n.s., 4: 616. 13 Nov 1875.  
*Dracaena* × *voluta* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena weismannii* Veitch, Gard. Chron. 1871: 841. 1 Jul 1871.  
*Dracaena* × *willsii* T.Moore, Gard. Chron., n.s., 4: 615. 13 Nov 1875.  
*Dracaena youngii* E.Morren, Belgique Hort. 22: 354. Dec 1872.  
*Funckia liliifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 47. 1 Apr 1871.  
*Funckia platyginifolia* H.A.Dreer, Gard. Monthly Hort. 10: 64 [Hort. Advert. unpag.], Feb 1868.  
*Scilla hughii* Mast. & T.Moore, Gard. Chron., n. s., 1: 26. 3 Jan 1874.  
*Smilacina oligophylla* Baker ex Elwes, Garden (London) 6: 191. 29 Aug 1874.

#### Asteriaceae Dumort.

*Astelia bivittata* Watson, Proc. Roy. Hort. Soc. 46: 159. Oct 1864.

#### Asteraceae Bercht. & J.Presl

- Adenostyleae* Cass. in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 14. 1834.  
*Aster rubicaulis* Gera, Nuovo Diz. Univ. Agric. 6: 494. 1837.  
*Boltonia laevigata* E. Witte, Ned. Tuinbouwhl. Sempervirens 1: 419. 10 Oct 1903.  
*Coreopsis elegans* Loisel., Herb. Gén. Amateur 7: ad t. 450. 1824.  
*Senecio giesbreghtii* Brongn. ex Clémenc., Rev. Hort. 46: 100. 1 Mar 1874.  
*Starkea odoratissima* Haage & Schmidt, Pfl.-Cat. 1874: 6. Jan 1874.

#### Begoniaceae C. Agardh

- Begonia diadem* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 138. 1 Apr 1871.  
*Begonia* × *hybrida* P.W.Burbidge, Cultivated Pl. 202. 1877.  
*Begonia* × *valida* P.W.Burbidge, Cultivated Pl. 202. 1877.  
*Begonia vesuvius* Veitch, Garden (London) 4: 204. 6 Sep 1873.  
*Begonia weltoniensis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 139. 1 Apr 1871.

#### Berberidaceae Juss.

*Berberis cordiformis* W.Bull, Gard. Chron., n.s., 1: 532. 25 Apr 1874.



**Betulaceae Gray**

*Alnus imperialis* (Hemsl.) Rob., Gard. Chron., n.s., 2: 334. 12 Sep 1874.

*Betula purpurea* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875.

**Bignoniaceae Juss.**

*Bignonia roezliana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 4. 1 Apr 1871.

*Campsidium filicifolium* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.

*Catalpa* × *aureovittata* Carrière, Rev. Hort. 46: 140. 1 Apr 1874.

**Blechnaceae Newman**

*Lomaria dobroydensis* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875.

*Struthiopteris japonica* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 121. 1 Apr 1871.

**Brassicaceae Burnett**

*Aethionema purpureum* F.G.Sealey, Gard. Chron. 36: 73. 1932.

*Aubrieta hendersonii* E.G.Hend., Gard. Chron., n.s., 1: 2. 3 Jan 1874.

*Brassica rutabaga* Vilm., Bon Jard. 345. 1837.

*Brassica-napus* Vilm., Bon Jard. 348. 1837.

*Brassica-napus sylvestris* Vilm., Bon Jard. 348. 1837.

*Sennebiera pinnatifida* Poit., Bon Jard. 294. 1837.

**Bromeliaceae Juss.**

*Ananas mordilona* Linden, Cat. Pl. Exot. 22/23: 2. Jan-Jun 1869.

*Billbergia musaica* (Linden & André) Regel, Gartenflora 23: 378. Dec 1874.

*Disteganthus scarlatinus* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.

*Dyckia lemnaeana* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.

*Dyckia splendens* Anderson., Gard. Chron., n.s., 4: 227. 21 Aug 1875.

*Pitcairnia floccosa* Regel, Gartenflora 23: 307. Oct 1874.

*Pourretia yuccoides* Linden, Supp. Extrait Cat. Gén. 82/24: 12. 1 Jul 1869.

*Tillandsia lindenbergii* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 6. Aug 1868.

*Tillandsia mosaic* Linden ex Rafarin, Rev. Hort. 46: 73. 16 Feb 1874.

*Tillandsia roezlii* Linden ex Ortgies, Gartenflora 23: 47. Jan 1874.

*Vriesea reticulata* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.

**Cactaceae Juss.**

*Pilocereus dautwitzii* J.N.Haage, Gard. Chron. 1873: 7. 4 Jan 1873.

*Pilocereus hoppenstedtii* Haage & Schmidt, Pfl.-Cat. 1874: 5. Jan 1874.

**Calceolariaceae Olmstead**

*Calceolaria discolor* Herb., Amaryllidaceae 363. late Apr 1837.

**Campanulaceae Juss.**

*Adenophora farreri* S.Arnott, Gard. Chron., ser. 3, 86: 183. 7 Sep 1929.

*Campanula* × *smithii* Hort., Gard. Chron., n.s., 2: 83. 18 Jul 1874.

*Centropogon lucyanus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 19. 1 Apr 1871.

*Lobelia gordonii* T.Moore, Proc. Roy. Hort. Soc. 4: 47, 195. Dec 1864.

*Lobelia paxtoniana* T.Moore, Proc. Roy. Hort. Soc. 4: 47, 195. Dec 1864.

# **Caprifoliaceae Juss.**

- Scabiosa parnassiae* Hort., Gard. Chron. 1873: 1175. 30 Aug 1873.  
*Weigela graciliflora* Carrière, Rev. Hort. 47: 211. 1 Jun 1875.  
*Weigela hendersonii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 54. 1871.  
*Weigela hybrida* Carrière, Rev. Hort. 47: 211. 1 Jun 1875.  
*Weigela lemoinei* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 54. 1 Apr 1871.  
*Weigela multiflora* Carrière, Rev. Hort. 47: 210. 1 Jun 1875.  
*Weigela mutabilis* Carrière, Rev. Hort. 1861: 331. 1861.  
*Weigela nivea* Carrière, Rev. Hort. 47: 130. 1 Apr 1875.  
*Weigela striata* B.K.Bliss, Hort. J. Rural Arts Rural Taste 17: 10. Apr 1862.  
*Weigela vanhouttii* B.K.Bliss, Hort. J. Rural Arts Rural Taste 17: 10. Apr 1862.

# **Caricaceae Dumort.**

- Carica aurantiaca* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Carica gracilis* Linden, Cat. Pl. Exot. 22/23: 24. Jan-Jun 1869.

# **Celastraceae R.Br.**

- Euonymus flavescens* W.Paul., Gardener 2: 383. Oct 1867.

# **Cephalotaceae Dumort.**

- Cephalotaxus robusta* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874.

# **Cibotiaceae Korall**

- Cibotum regale* Verschaff. ex Regel in Gartenfl. 14: 251. Aug-Sep 1865.  
*Cibotum spectabile* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 2. Aug 1868.

# **Colchicaceae DC.**

- Colchicum giganteum* Tubergen, Wholesale Cat. Flowerroots 17. 1903.  
*Ureolaria fulva* Herb., Amaryllidaceae 194, pl. 26, f. 5. Dec 1837, *nom. inadmis.*  
*Uvularia sinensis* Loudon, Gardener's Mag. 8: 111. Feb 1832, *nom. illeg.*

# **Crassulaceae J.St.-Hil.**

- Echeveria abyssinica* W.Bull, Retail List [Spec. List Gladiolus. 68:] 13. Sep-Oct 1872.  
*Echeveria* × *carinata* W.Bull, Retail List [Spec. List Gladiolus. 68:] 14. Sep-Oct 1872.  
*Echeveria exima* E.G.Hend. ex R.Hogg, Florist & Pomol. 27: 136. Jun 1874.  
*Echeveria* × *glaucometallica* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 151. 1 Apr 1871.  
*Echeveria globosa* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874.  
*Echeveria peacockii* J.Croucher, Gard. Chron., n.s. 1: 674. 23 May 1874.  
*Echeveria* × *rotundifolia* R.Dean, Gard. Chron., n.s., 4: 627. 13 Nov 1875.  
*Sedum californicum* E.G.Hend., Gard. Chron., n.s., 3: 795. 19 Jun 1875.  
*Sempervivum atlanticum* (Ball ex Hook.f.) Baker, Gard. Chron., n.s., 2: 104. 25 Jun 1874.  
*Sempervivum calcarum* Rob., Alpine Fl. Engl. Gard. 336. 1870, *nom. illeg.*  
*Sempervivum californicum* K.Koch, Wochenschr. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 167. 23 Mai 1863.

# **Cupressaceae Gray**

- Biota aurea* (Carrière) K.Koch, Dendrologie 2(2): 183. Nov 1873.  
*Biota defresneana* C. van Geert ex K.Koch, Wochenschr. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 119. 11 Apr 1863.  
*Cryptomeria lycopodioides* Carrière, Rev. Hort. 46: 220. 1 Jun 1874.

*Cupressus balfouriana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 45. 1 Apr 1871.

*Thuja defresneana* C. van Geert ex K.Koch, Wochensch. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 119. 11 Apr 1863.

*Thuja sempercaurea* Hort., Gard. Chron., n.s., 2: 303. 5 Sep 1874.

### **Cyatheaceae Kaulf.**

*Alsophila beyrichiana* (C. Presl) G., Garden (London) 5: 160. 21 Feb 1874.

*Alsophila elegantissima* Linden, Cat. Pl. Exot. 22/23: 57. Jan-Jun 1869.

*Cyathea microlepis* G., Garden (London) 5: 9. 3 Jan 1874.

### **Cycadaceae Pers.**

*Cycas ruminata* W.Bull, Proc. Roy. Hort. Soc. 4:134. Jul 1864.

### **Cyclanthaceae Poit. ex A.Rich.**

*Carludovica jonghei* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875.

*Carludovica lancaefolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875.

*Carludovica rotundifolia* Schaedtler, Hamburger Garten-Blumenzeitung 31: 301. Jul 1875.

*Cyclanthus estaba* Schaedtler, Hamburger Garten-Blumenzeitung 31: 302. Jul 1875.

### **Davalliaceae M.R.Schomb.**

*Davallia trifurcata* André, Rev. Hort. 67: 250. 1 Jun 1895.

*Davallia youngii* Veitch, Gard. Chron., n.s., 3: 795. 19 Jun 1875.

*Davallia tyermanii* (T.Moore) Veitch, Cat. New Beautiful Pl. 1873: 18. Jul-Aug 1873.

### **Dioscoreaceae R.Br.**

*Dioscorea illustrata* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.

### **Dryopteridaceae Herter**

*Dryopteris nobilis* J.Douglas, J. Hort. Cottage Gard. 11: 459. 18 Dec 1866.

### **Ebenaceae Gürke**

*Diospyros mazeltii* Carrière, Rev. Hort. 46: 70. 16 Feb 1874.

### **Ericaceae Juss.**

*Andromeda forrestii* (Harrow ex W.W.Sm.) C.K.Schneid. in Gartenbau im Reich 11: 209. 1930.

*Arbutus croomii* Rob., Garden (London) 6: 442. 14 Nov 1874.

*Arctostaphylos intermedia* Greene ex Howell, *Fl. N.W. Amer.* 1: 415. 1901, *nom. illeg.*

*Azalea × todmanii* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873.

*Erica denisoniana* Hort., Gard. Chron., n. s., 1: 739. 6 Jun 1874.

*Erica lindleyana* W.Holloway, Proc. Roy. Hort. Soc. 46: 159. Oct 1864.

*Rhododendron × ciliato-dauricum* Carrière, Rev. Hort. 46: 200. 16 Mai 1874.

*Vaccinium mortenii* J.M'Nab, Garden (London) 6: 206. 29 Aug 1874.

### **Euphorbiaceae Juss.**

*Codiaeum angustifolium* Hort., Gard. Chron., n.s., 1: 664. 23 May 1874.

*Croton aucubifolius* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869.

*Croton chrysophyllum* W.Bull. Gard. Chron., n.s., 3: 523. 24 Apr 1875.

*Croton cooperi* Hort., Gard. Chron., n.s., 1: 836. 27 Jun 1874.

*Croton cornutus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 20. 1 Apr 1871.

*Croton disraelii* Veitch, Gard. Chron., n.s. 3: 473. 10 Apr 1875.

- Croton fucatus* W.Bull, Retail List [Spec. List Gladiolus. 68:] 13. Sep-Oct 1872.  
*Croton harwoodianum* Hort., Gard. Chron., n.s., 3: 602. 8 May 1875.  
*Croton hillianus* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869.  
*Croton interruptus* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868.  
*Croton irregularis* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871.  
*Croton lacteum* Veitch, Cat. New Beautiful Pl. 1873: 37. Jul-Aug 1873.  
*Croton limbatum* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Croton majesticum* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874.  
*Croton maximus* Linden, Supp. Extrait Cat. Gén. 82/24: 5. 1 Jul 1869.  
*Croton picturatum* W.Bull, Gard. Chron., n.s., 3: 795. 19 Jun 1875.  
*Croton tortile* Veitch, Gard. Chron., n.s. 3: 474. 10 Apr 1875.  
*Croton trilobum* W.Bull, Hamburger Garten-Blumenzeitung 31: 446. Oct 1875.  
*Croton undulatus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871.  
*Croton veitchii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 20. 1 Apr 1871.  
*Croton volutum* Hort., Gard. Chron., n.s., 1: 690. 30 May 1874.  
*Croton weismannii* Veitch, Gard. Chron. 1868: 659. 1868.  
*Croton youngii* Veitch, Gard. Chron. 1873: 706. 24 Mai 1873.  
*Phyllanthus nivosus* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Ricinus gibsonii* Veitch, Gard. Chron., n.s., 2: 610. 14 Nov 1874.

#### **Fabaceae Lindl.**

- Acacia oleifolia* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 111. 1834, *nom. illeg.*  
*Acacia scandens* (L.) Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 117. 1834, *nom. illeg.*  
*Acacia spini* Gera, Nouv. Diz. Univ. Ragion. Agric. 1: 123. 1834.  
*Adenanthra ossea* Mannetti in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 2: 141. 1834, *nom. illeg.*  
*Anthyllis spinosa* Franceschi in F.A. Gera, Nouv. Diz. Univ. Ragion. Agric. 4: 901, 902. 1835.  
*Caesalpinia alternifolia* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 19. 1 Apr 1871.  
*Cytisus everestianus* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 35. 1 Apr 1871.  
*Erythrina bogotensis* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.  
*Erythrina compacta* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 4. 1 Apr 1871.  
*Erythrina fulgens* Loisel., Herb. Gén. Amateur 4: ad t. 247. 1820.  
*Erythrina parcelii* Dombrain, Flor. Mag., n.s., 3: ad t. 95. Dec 1873.  
*Gleditsia subvirescens* Poit., Bon Jard. 893 ["93"]. 1837.  
*Indigofera atropurpurea* Buch.-Ham. Ex Hornemann, Hort. Bot. Hafn. Suppl. 152. 1819.  
*Indigofera bilabiata* Loisel., Herb. Gén. Amateur 6: ad t. 392. 1822.  
*Kennedia fredwoodii* W.Bull, Proc. Roy. Hort. Soc. 4: 21. Feb 1864.  
*Lathyrus sibthorpii* Haage & Schmidt, Pfl.-Cat. 1874: 4. Jan 1874.  
*Mimosa conspicua* Poit., Bon Jard. 890. 1837.  
*Sophora pendula* Ounous, Rev. Hort. 46: 280. 16 Jul 1874.

#### **Fagaceae Dumort.**

- Quercus afghanistanensis* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873.  
*Quercus concordia* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873.  
*Quercus pectinata* Hort., Gard. Chron. 1873: 1404. 18 Oct 1873.  
*Quercus salicifolia* Siebold ex J.W.Ottol., Gard. Chron., n.s., 1: 726. 6 Jun 1874, *nom. illeg.*

#### **Garryaceae Lindl.**

- Aucuba vivicans* W.Bull, Gard. Chron., n.s., 3: 619. 15 May 1875.

**Gentianaceae Juss.**

*Chironia ixifera* W.Bull, Gard. Chron., n.s., 2: 294. 5 Sep 1874.

*Pelargonium × rienzii* Cannell ex T.Moore, Florist & Pomol. 28: 116. Mai 1875.

*Pelargonium lycopodioides* Carrière, Rev. Hort. 46: 38. 16 Jan 1874.

**Geraniaceae Juss.**

*Pelargonium pseudozonale* Huber, Florist & Pomol. 28: 68. Mar 1875.

*Pelargonium sanguineum* Loisel., Herb. Gén. Amateur 5: ad t. 320. 1821, *nom. illeg.*

**Gesneriaceae Rich. & Juss.**

*Alloplectus bicolor* Linden, Cat. Pl. Exot. 22/23: 1. Jan-Jun 1869, *nom. illeg.*

*Gloxinia hieroglyphica* Wilh.Busch. ex Ed.Otto, Hamburger Garten-Blumenzeitung 31: 473. Oct 1875.

*Gloxinia hybrida* Mountjoy, Floric. Cab. & Florist's Mag. 8: 156. 1840.

*Streptocarpus × greenei* Green, Gard. Chron., n.s., 4: 180. 7 Aug 1875.

**Griselinaceae J.R.Forst. & G.Forst. ex A.Cunn.**

*Griselinia macrophylla* (Hook.f.) Burb., Domestic Floricult. 287. 1874.

**Heliconiaceae Vines**

*Heliconia vinosa* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 5. 1 Apr 1871.

**Iridaceae Juss.**

*Crocus napolitanus* Loisel., Herb. Gén. Amateur 2: ad t. 101. 1817, *nom. illeg.*

*Freesia leichtliniana* Klatt ex Rob., Garden (London) 6: 215. 5 Sep 1874.

*Gladiolus × brenchleyensis* Hort, Ann. Hort.: 523. Sep 1848.

*Gladiolus oppositiflorus* Herb., Amaryllidaceae 366. late Apr 1837.

*Iris ciengialtii* Tubergen, Wholesale Cat. Flowerroots 22. Mai 1901.

*Iris eggertii* Tubergen, Wholesale Cat. Flowerroots 23. Mai 1901.

**Juglandaceae DC. ex Perleb**

*Juglans macrophylla* Haage & Schmidt, Pfl.-Cat. 1874: 4. Jan 1874.

*Juglans segraisiensis* M.B.Verlot, J. Soc. Cent. Hort. France, sér. 2, 8: 281. 30 Jun 1875.

**Lamiaceae Martinov**

*Agnus-castus alba* Carrière, Rev. Hort. 46: 400. 16 Oct 1874.

*Agnus-castus marostachya* Carrière, Rev. Hort. 46: 400. 16 Oct 1874.

*Clerodendrum balfourianum* Hort., Gard. Chron., n.s., 3: 667. 22 Mai 1877.

*Coleus × batemanni* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus × bausei* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus × berkeleyi* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868.

*Coleus × clarkei* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus × dixii* H. T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868.

*Coleus marmoratus* W.Bull, Proc. Roy. Hort. Soc. 4:133. Jul 1864.

*Coleus × murrayi* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus × reveesii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus × ruckertii* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868.

*Coleus × saundersii* T.Moore, Gard. Chron. 1868: 376. 11 Apr 1868.

*Coleus × scottii* T.Moore, Gard. Chron. 1868: 377. 11 Apr 1868.

*Coleus telfordii* McPhail ex H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 3. Aug 1868.

*Scutellaria moccintana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871.

#### **Lecythidaceae A. Rich.**

*Grias zamorensis* Linden, Cat. Pl. Exot. 22/23: 6. Jan-Jun 1869.

*Lecythis nobilis* Linden, Cat. Pl. Exot. 22/23: 26. Jan-Jun 1869.

#### **Liliaceae Juss.**

*Calochortus krelagei* (Regel) Ortgies, Gartenflora 23: 49. Jan 1874.

*Cyclobothra maweana* Tubergen, Wholesale Cat. Flowerroots 14. 1892.

*Fritillaria inodora* Tubergen, Wholesale Cat. Flowerroots 19. 1892.

*Lilium takesima* Morren, J. Soc. Natl. Hort. France, sér. 1, 7: 460. Jul 1861.

*Lilium wallacei* Tubergen, Wholesale Cat. Flowerroots 25. 1892.

*Methonica senegalensis* Poit., Bon Jard. 507. 1837.

*Methonica simplex* Poit., Bon Jard. 507. 1837.

*Tulipa viridiflora* Tubergen, Wholesale Cat. Flowerroots 11. 1892.

#### **Loasaceae Juss.**

*Blumenbachtia coronata* Rob., J. Hort. Pract. Gard. 25: 216. 18 Sep 1873.

#### **Lythraceae J.St.-Hil.**

*Punica legrellei* Haage & Schmidt, Pl.-Verzeichn. 2. Jan 1875.

#### **Malvaceae Juss.**

*Abutilon savitzi* André, Rev. Hort. 67: 249. 1 Jun 1895.

*Entelea bakeri* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 36. 1 Apr 1871.

*Hibiscus albovariegata* W.Bull, Retail List [Spec. List Gladiolus. 68:] 14. Sep-Oct 1872.

*Hibiscus carminata-perfecta* W.Bull, Retail List [Spec. List Gladiolus. 68:] 14. Sep-Oct 1872.

*Hibiscus fulgidus* W.Bull, Gard. Chron. 1873: 606. 3 Mai 1873.

#### **Marantaceae R.Br.**

*Maranta chimboracensis* Linden, Cat. Pl. Exot. 22/23: 6. Jan-Jun 1869.

*Maranta concinna* W.Bull, Gard. Chron., n.s., 1: 78. 17 Jan 1874.

*Maranta tubispatha* Linden, Supp. Extrait Cat. Gén. 82/24: 9. 1 Jul 1869.

#### **Melastomataceae Juss.**

*Bertolonia × marchandii* T.Moore, Florist & Pomol. 28: 143. Jun 1875.

*Bertolonia pubescens* G.W.Johns. & R.Hogg, J. Hort. Cottage Gard, n.s., 8: 397. 23 Mai 1865.

*Bertolonia punctata* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 3. 1 Apr 1871.

*Bertolonia × vanhouttei* T.Moore, Florist & Pomol. 28: 143. Jun 1875.

*Cyanophyllum bowmannii* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 21. 1 Apr 1871.

*Cyanophyllum marmoreum* Linden ex Ender, Gartenflora 24: 360. 1 Dec 1875.

*Cyanophyllum spectandum* Linden, Cat. Pl. Exot. 22/23: 4. Jan-Jun 1869.

*Miconia argyrea* Veitch, Proc. Roy. Hort. Soc. 3:280. 29 Mai 1869.

*Miconia peruviana* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 5. Aug 1868.

*Sonerila hendersonii* E.G.Hend., Garden (London) 6: 63. 18 Jul 1874.

*Sphaerogyne ferruginea* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 30. 1 Apr 1871.

**Moraceae** Gaudich.

- Artocarpus calophylla* Haage & Schmidt, Pfl.-Cat. 1874: 1. Jan 1874.  
*Artocarpus cannoni* Veitch, Gard. Chron., n.s., 4: 242. 21 Aug 1875.  
*Artocarpus grandis* Linden ex Cazzuola & Nencioni, Cultiv. Piante Ornam., ed. 2, 222. 1889.  
*Artocarpus neo-caledonica* Linden ex Cazzuola & Nencioni, Cultiv. Piante Ornam., ed. 2, 222. 1889.  
*Ficus dealbata* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868.  
*Ficus parcellii* Veitch, Gard. Chron., n.s., 1: 531. 25 Apr 1874.  
*Ficus wendlandea* Rafarin, Rev. Hort. 46: 75. 16 Feb 1874.

**Musaceae** Juss.

- Musa africana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 6. 1 Apr 1871.

**Nepenthaceae** Dumort.

- Nepenthes cuneata* Veitch, Gard. Chron., n.s., 4: 368. 18 Sep 1875.

**Oleaceae** Hoffmanns. & Link

- Ligustrum coriaceum* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 48. 1 Apr 1871.  
*Osmanthus rotundifolius* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 51. 1 Apr 1871.

**Onagraceae** Juss.

- Clarkia integripetala* S.O.Johnson, Rural Affairs 6: 198, fig. 108. 1877.  
*Fuchsia desideratum* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874.  
*Fuchsia grandidens* B.S.Williams, Gard. Chron., n.s., 1: 363. 21 Mar 1874.

**Orchidaceae** Juss.

- Aerides fieldingii* B.S.Williams, Orch. Grow. Man., ed. 2, 39. Oct 1862.  
*Aerides huttonii* (Hook.f.) Veitch, Cat. New Beautiful Pl. 1873: 16. Jul-Aug 1873.  
*Aerides lobbii* B.S.Williams, Orch. Grow. Man., ed. 2, 39. Oct 1862.  
*Aerides nobilis* B.S.Williams, Orch. Grow. Man., ed. 2, 40. Oct 1862.  
*Aerides veitchii* B.S.Williams, Orch. Grow. Man., ed. 2, 41. Oct 1862.  
*Aerides williamsii* B.S.Williams, Orch. Grow. Man., ed. 2, 43. Oct 1862.  
*Anoectochilus javanicus* (Blume) B.S.Williams, Orch. Grow. Man., ed. 2, 49. Oct 1862.  
*Anoectochilus lobbii* B.S.Williams, Orch. Grow. Man., ed. 2, 49. Oct 1862.  
*Anoectochilus maculatus* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862.  
*Anoectochilus querceticolus* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862.  
*Anoectochilus veitchii* B.S.Williams, Orch. Grow. Man., ed. 2, 50. Oct 1862.  
*Anoectochilus zebrinum* W.Bull, Proc. Roy. Hort. Soc. 4: 9. Jan 1864.  
*Batemannia burtii* W.B.Hume, Florist & Pomol. 27: 60. Mar 1874.  
*Burlingtonia amoena* B.S.Williams, Orch. Grow. Man., ed. 2, 62. Oct 1862.  
*Burlingtonia knowlesii* B.S.Williams, Orch. Grow. Man., ed. 2, 63. Oct 1862.  
*Cattleya amabilis* B.S.Williams, Orch. Grow. Man., ed. 2, 63. Oct 1862.  
*Cattleya edithiana* B.S.Williams, Orch. Grow. Man., ed. 2, 70. Oct 1862.  
*Cattleya × irrorata* (Rehb.f.) Low, Proc. Roy. Hort. Soc. 4: 8. Jan 1864.  
*Cattleya lutea* Guidon, J. Soc. Cent. Hort. France 4: 250. Apr 1858.  
*Cattleya memorandii* B.S.Williams, Orch. Grow. Man., ed. 2, 74. Oct 1862.  
*Coelogyne lowii* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862.  
*Coelogyne meadia* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862.  
*Coryanthes speciosa* B.S.Williams, Orch. Grow. Man., ed. 2, 80. Oct 1862.  
*Cypripedium biflorum* B.S.Williams, Orch. Grow. Man., ed. 2, 85. Oct 1862.  
*Cypripedium dayii* B.S.Williams, Orch. Grow. Man., ed. 2, 85. Oct 1862.

*Cypripedium longifolium* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 61. 1 Apr 1871, *nom. illeg.*

*Cypripedium* × *marshallianum* Rehb.f., Gard. Chron., n.s., 4: 804. 25 Dec 1875.

*Cypripedium pearcii* Veitch, Proc. Roy. Hort. Soc. 4:133. Jul 1864.

*Cypripedium* × *selligerum* Veitch, Gard. Chron., n.s., 3: 728. 5 Mai 1875.

*Dendrobium* × *atnsworthii* W.Mitch., Garden (London) 5: 176. 21 Feb 1874.

*Dendrobium citrinum* W.Bull, Garden (London) 5: 502. 13 Jun 1874.

*Dendrobium eburneum* Low, Proc. Roy. Hort. Soc. 4: 8. Jan 1864.

*Dendrobium parishii* Low, Proc. Roy. Hort. Soc. 3:281. 29 Mai 1863.

*Dendrobium wallichianum* B.S.Williams, Orch. Grow. Man., ed. 2, 98. Oct 1862.

*Epidendrum hanburyanum* B.S.Williams, Orch. Grow. Man., ed. 2, 100. Oct 1862.

*Epidendrum syringothyrsus* Veitch, Cat. New Beautiful Pl. 1873: 19. Jul-Aug 1873.

*Goodyera dawsoniana* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 66. 1 Apr 1871.

*Goodyera dawsonii* Boxall, Garden (London) 6: 197. 29 Aug 1874.

*Goodyera* × *dominti* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862.

*Goodyera picta* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862.

*Goodyera rubrovenia* B.S.Williams, Orch. Grow. Man., ed. 2, 105. Oct 1862.

*Huntleya wailestae* B.S.Williams, Orch. Grow. Man., ed. 2, 109. Oct 1862.

*Laelia gigantea* R.Warner, Proc. Roy. Hort. Soc. 2:247. Mai 1862.

*Laelia maryanii* B.S.Williams, Orch. Grow. Man., ed. 2, 113. Oct 1862.

*Masdevallia harr yana* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872.

*Masdevallia ignea* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872.

*Miltonia morelii* B.S.Williams, Orch. Grow. Man., ed. 2, 119. Oct 1862.

*Mormodes citrina* B.S.Williams, Orch. Grow. Man., ed. 2, 120. Oct 1862.

*Odontoglossum caradenti* Veitch, Garden (London) 5: 256. 21 Mar 1874.

*Odontoglossum maxillare* J.B.Norman, Gard. Chron., n.s., 2: 309. 5 Sep 1974, *nom. illeg.*

*Odontoglossum roezlii* W.Bull, Garden (London) 4: 20 Sep 1873.

*Oeceoclades guineensis* W.Bull, Gard. Chron., n.s., 2: 309. 5 Sep 1874.

*Oncidium batemanii* B.S.Williams, Orch. Grow. Man., ed. 2, 125. Oct 1862.

*Oncidium cavendishii* B.S.Williams, Orch. Grow. Man., ed. 2, 126. Oct 1862.

*Oncidium kramerii* J.Muir, Garden (London) 6: 384. 24 Oct 1874.

*Oncidium roezliianum* W.Bull, Retail List [Wholesale List New Beautiful Rare Pl. 60:] 71. 1 Apr 1871.

*Paphia tigrina* B.S.Williams, Orch. Grow. Man., ed. 2, 131. Oct 1862.

*Pescatoria albosanguinea* W.Bull, Garden (London) 5: 538. 20 Jun 1874.

*Phalaenopsis lobbitii* (Rehb.f.) B.S.Williams, Orch. Grow. Man., ed. 2, 136. Oct 1862.

*Saccolabium furcatum* B.S.Williams, Orch. Grow. Man., ed. 2, 141. Oct 1862.

*Vanda pygmaea* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 20. Aug 1868.

## **Osmundaceae Martinov**

*Leptopteris intermedia* G., Garden (London) 5: 414. 16 May 1874.

*Leptopteris wilkesiana* (Brack.) G., Garden (London) 5: 414. 16 May 1874.

## **Pandanaceae R.Br.**

*Pandanus ceramensis* W.Bull, Retail List [Spec. List Gladiolus. 68:] 15. Sep-Oct 1872.

*Pandanus gramineus* (Blume) H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 22. Aug 1868.

*Pandanus inneri* Schaedtler, Hamburger Garten-Blumenzeitung 31: 298. Jul 1875.



**Papaveraceae Juss.**

*Bocconia japonica* Haage & Schmidt, Pl. Cat. 36. Jan 1870.  
*Bocconia jedoensis* Carrière, Rev. Hort. 37: 340. 15-31 Aug 1866.

**Passifloraceae Juss. ex Roussel**

*Passiflora macrocarpa* Linden, Cat. Pl. Exot. 22/23: 27. Jan-Jun 1869.

**Phrymaceae Schauer**

*Mimulus exquissitus* J.Muir, Garden (London) 6: 46. 18 Jun 1874.  
*Mimulus maculosus* J.Muir, Garden (London) 6: 46. 18 Jun 1874.  
*Mimulus meteor* J.Muir, Garden (London) 6: 46. 18 Jun 1874.

**Phytolaccaceae R.Br.**

*Ledenbergia roseo-aenea* Lem. ex Linden, Supp. Extrait Cat. Gén. 82/24: 8. 1 Jul 1869.

**Pinaceae Spreng. ex F. Rudolphi**

*Abies brachyptera* Rafarin, Rev. Hort. 46: 74. 16 Feb 1874.  
*Abies commutata* A.Murray, Gard. Chron., n.s., 3: 106. 23 Jan 1875.  
*Abies dicksonii* C. van Geert ex K.Koch, Wochensch. Vereines Beförd. Gartenbaues Königl. Preuss. Staaten 6: 119. 11 Apr 1863.  
*Abies hanburyana* A.Murray, Garden (London) 6: 272. 19 Sep 1874, *nom. illeg.*  
*Picea hookeriana* (A.Murray) Roetzl, Rev. Hort. 47: unpagged. 16 Feb 1875.  
*Picea lambertiana* (Douglas) F.Sander, Gard. Chron., n.s., 2: 702. 5 Dec 1874.  
*Picea magnifica* (A.Murray) F.Sanders, Gard. Chron., n.s., 2: 702. 5 Dec 1874.  
*Picea parsoniana* E.Manning, Gard. Monthly Hort. 10: 109. Apr 1868.  
*Picea pyrenaica* E.Manning, Gard. Monthly Hort. 10: 109. Apr 1868.  
*Pinus hookeriana* (A.Murray) W.R.McNab, Gard. Chron., n.s., 4: 711. 4 Dec 1875.  
*Pinus pattonii* A.Murray, Phytologist 4: 1140. Dec 1853.  
*Pinus sieboldii* A.Murray, Phytologist 4: 1140. Dec 1853, *nom. illeg.*

**Piperaceae Giseke**

*Peperomia argentea* Sallier, Rev. Hort. 55: 323. 16 Jul 1883.  
*Peperomia verschaefeltii* Linden, Supp. Extrait Cat. Gén. 82/24: 10. 1 Jul 1869.

**Plantaginaceae Juss.**

*Antirrhinum numidicum* Haage & Schmidt, Haupt-Verz. Samen 1875: 67. Jan 1875.

**Plumbaginaceae Juss.**

*Acantholimon spinosum* Rob., Gard. Chron., ser. 3, 96: 31. 14 Jul 1934.  
*Armeria echioides* Dennst., Hort. Belveder. 1: 95. 1820, *nom. illeg.*  
*Armeria lauchiana* Haage & Schmidt, Pl.-Verzeichn. 2. Jan 1875.

**Poaceae Barnhart**

*Briza compacta* H.A.Dreer, Gard. Monthly Hort. 10: 64 [Hort. Advert. unpagged]. Feb 1868.

**Polemoniaceae Juss.**

*Phlox nelsonii* G.W.Johnson & Hogg, J. Hort. Cottage Gard., n.s., 28: 366. 13 Mai 1875.

**Polygalaceae Hoffmanns. & Link**

*Polygala dalmaisiana* T.Baines, Gard. Chron., n.s., 2: 617. 14 Nov 1874.

**Polygonaceae Juss.**

*Persicaria alata* (Buch.-Ham. ex D.Don) Nakai, Rept. Veg. Ooryongto 18. 1919.

*Persicaria filiformis* (Thunb.) Nakai, Rept. Veg. Ooryongto 18. 1919.

*Persicaria posumbu* (Buch.-Ham. ex D.Don) H.Gross in Engl. Bot. Jahrb. Syst. 49: 313. 1913.

*Reynoutria compacta* (Hook.f.) Nakai, Rigakkai 24: 293. 1926.

**Primulaceae Batsch ex Borkh.**

*Theophrasta andrea* Linden ex Rafarin, Rev. Hort. 46: 76. 16 Feb 1874.

**Proteaceae Juss.**

*Embothrium despardii* Hort., Gard. Chron., n.s., 3: 371. 20 Mar 1875.

**Pteridaceae E.D.M.Kirchn.**

*Gymnogramma pearcei* Veitch, Proc. Roy. Hort. Soc. 4: 72. Apr 1864.

*Gymnogramma* × *steizneriana* H.Laurentius, Cat. Gewächsh.-Pfl. Herbst-Cat. 40: 4. Aug 1868.

*Pteris* × *serulato-tremula* T.Moore, Gard. Chron., n.s., 1: 92. 17 Jan 1874.

**Ranunculaceae Juss.**

*Aquilegia caryophylloides* S.Hibberd in Floral World Gard. Guide: 142. Jul 1860.

*Atragene ceilanica* (Thunb.) Gera, Nuovo Diz. Univ. Agric. 6: 507. 1837.

*Caltha grandiflora* (Robert) Rob., Garden (London) 6: 47. 18 Jul 1874.

*Clematis atropurpurea* Spae ex T.Moore & Jackman, Clematis 82. Sep-Dec 1872.

*Clematis* × *aureliana* Briolay-Goiffon ex T.Moore & Jackman, Clematis 83. Sep-Dec 1872.

*Clematis calypso* Lemoine ex T.Moore & Jackman, Clematis 86. Sep-Dec 1872.

*Clematis crispis* R.D., Florist & Pomol. 3: 214. Sep 1870.

*Clematis* × *fulgens* Simon-Louis ex T.Moore & Jackman, Clematis 100. Sep-Dec 1872.

*Clematis* × *henryi* Anderson-Henry ex T.Moore & Jackman, Clematis 106. Sep-Dec 1872.

*Clematis henryi* Oliv., Hooker's Icon. Pl. 19: ad t. 1819. Jan 1889, *nom. illeg.*

*Clematis imperialis* Carré ex T.Moore & Jackman, Clematis 107. Sep-Dec 1872.

*Clematis insignis* T.Moore & Jackman, Clematis 107. Sep-Dec 1872.

*Clematis magnifica* T.Moore, Fl. Mag. ; ad t. 8: 453. 1869.

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*Rosa terebinthina* (Thory) Tratt., Rosac. Monogr. 1: 111. Jul-Dec 1823, *nom. illeg.*  
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## A NEW COMBINATION IN *VIBURNUM* SECT. *ODONTOTINUS* (ADOXACEAE)

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### ABSTRACT

Plants generally identified as *Viburnum dentatum* var. *deamii* (Rehder) Fernald (*V. pubescens* var. *deamii* Rehder) are distinct from *V. dentatum* in the presence of stipules and stipitate-glandular cymes and are appropriately treated at specific rank: *Viburnum deamii* (Rehder) Sorrie, comb. nov. *Viburnum dentatum* var. *indianense* (Rehder) Gleason (*V. pubescens* var. *indianense* Rehder) is a synonym of *V. deamii*.

**KEY WORDS:** *Viburnum deamii* (Rehder) Sorrie, Adoxaceae, *Viburnum dentatum*, *Viburnum* sect. *Odontotinus*

Rehder (1924) described two new entities from the Ohio River Basin and placed them within *Viburnum pubescens* (Aiton) Pursh: *V. pubescens* var. *deamii* Rehder and *V. pubescens* var. *indianense* Rehder. Later, Svenson (1940) argued convincingly that *V. pubescens* is a later name for *V. dentatum* L. in the broad sense, thus leading to combinations authored by Fernald (1941) and Gleason (1952a, b) that transferred each of the two varieties to *V. dentatum*.

McAtee (1956) placed excessive emphasis on leaf vestiture in maintaining var. *deamii* and var. *indianense* as infraspecific taxa within *Viburnum dentatum*. Var. *deamii* is more or less densely pubescent on leaf undersides and has stellate hairs over the entire petiole. Var. *indianense* has glabrate leaf undersides and petiole hairs are more or less confined to the groove on the upper surface. Many intermediates exist, however, and numerous herbarium specimens cannot readily be assigned. Moreover, both taxa overlap greatly in range and occupy identical habitats. These two taxa do not appear to be clearly separable from one another as distinct entities.

While the stellate pubescent leaves and petioles of *Viburnum dentatum* var. *deamii* superficially align it with typical *V. dentatum*, the stipules and stipitate-glandular cymes of var. *deamii* more strongly argue for evolutionary affinity with *V. bracteatum*. Additional research is needed to resolve relationships. Meanwhile, it is prudent to emphasize the robust distinctions between typical *V. dentatum* and *V. dentatum* var. *deamii* by treating the latter at specific rank.

*Viburnum deamii* (Rehder) Sorrie, comb. et stat. nov. *Viburnum pubescens* var. *deamii* Rehder, J. Arnold Arb. 5: 58. 1924. *Viburnum dentatum* var. *deamii* (Rehder) Fernald, Rhodora 43: 649. 1941.

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**CRATAEGUS CHRYSOCARPA ASHE VAR. PHOENICEA**  
**(SER. ROTUNDIFOLIAE; ROSACEAE)**

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**ABSTRACT**

E.J. Palmer's widely used varietal name *Crataegus chrysocarpa* var. *phoenicea* was not typified in its original description of 1937 and is validated here as *Crataegus chrysocarpa* var. *phoenicea* E.J. Palmer ex J.B. Phipps, var. nov.

**KEY WORDS:** *Crataegus chrysocarpa* var. *phoenicea*, *Crataegus abortivum*, *Crataegus dodgei*, *Crataegus flavida*, Rosaceae

*Crataegus chrysocarpa* Ashe var. *phoenicea* was described by E.J. Palmer in Dole's Flora of Vermont (1937) but unfortunately rather briefly and without designation of a type. This has led to a very wide interpretation of this taxon so as to include a variety of *Crataegus chrysocarpa*-like plants with glabrous inflorescences. Collectively these plants are widely found from the Great Lakes region to the St. Lawrence Valley and New England and are mostly seemingly intermediate between var. *chrysocarpa* and *Crataegus dodgei* Ashe. As other taxa may be involved, the distribution statement given below for var. *phoenicea* is uncertain.

This paper typifies *Crataegus chrysocarpa* var. *phoenicea* from Palmer's original material and provides a more complete description. Type specimens are selected so as to maintain the intent of Palmer's usage.

**Crataegus chrysocarpa** Ashe var. **phoenicea** E.J. Palmer ex J.B. Phipps, var. nov. Figs. 1, 2, and 3.

**TYPE:** USA. Vermont. Addison Co.: Ferrisburg, 22 Aug 1941, *R.C. Bean C6* (holotype [designated here] A!; isotype: A!). The type is a good fruiting specimen from Vermont, annotated by Palmer and having glabrous infructescence branches. Because indumentum is quite often not persistent, however, this fruiting season glabrousness is not definitively predictive of early season glabrousness. **EPITYPE** (designated here): USA. Rhode Island. Kent Co.: Bristol, 28 May 1939, *E.J. Palmer 44757* (A!). Inadequacy of the fruiting holotype requires the selection of an epitype and unavailability of a suitable flowering specimen from the geographic area of the holotype leads to the selection of an epitype from Rhode Island. The specimen chosen is an excellent flowering specimen annotated by Palmer and having all the diagnostic characteristics of the variety.

**Bushes**, 2-3 m. **Leaves:** petioles glabrous, with a few small glands or eglandular; blades 2.5-4 cm long, ovate to rhombovate, bases broad-cuneate, lobes acute, max. indentations 15-20%, veins 3-5 per side, glabrous. **Inflorescences:** 5-10-flowered; branches glabrous; lower bracteoles with sessile glands. **Flowers:** 15-20 mm diam.; hypanthia externally glabrous; sepals glandular-denticulate/serrate; stamens 10, anthers cream or ivory. **Pomes:** red, subglobose, 8-10 mm diam., glabrous.

Flowering May-Jun; fruiting Sep-Oct. Open brushy places; 50-350 m. Ont., Que.; R.I., Vt.; local. Reports from Conn., Mass., Me., N.Y., and Wis. should be re-examined.



Figure 1. Herbarium specimen of *Crataegus chrysocarpa* var. *phoenicea* in fruit cropped to enhance detail (isotype, from Vermont)



Figure 2. Herbarium specimen of *Crataegus chrysocarpa* var. *phoenicea* in flower cropped to enhance detail (epitype, from Rhode Island)



Figure 3. (a) inflorescence from part of epitype showing glabrous pedicels and a residual larger type bracteole with all glands sessile. (b) Infructescence from part of isotype showing glabrous pedicels and fruit

*Crataegus chrysocarpa* var. *phoenicea*, as here elucidated, is similar to typical forms of var. *chrysocarpa* in stature, leaf shape (Figs. 1, 2; +/- ovate or rhombovate with angular lobes), and fruit color (red) but differs by being completely glabrous (Figs. 3a, 3b) and having somewhat less deeply serrate sepals (Fig. 3a). Its larger lower bracteoles are somewhat narrow-elliptic (Fig. 3a) in the manner of the *C. flavida* Sargent of the *C. dodget* group (also ser. *Rotundifoliae*). However, unlike *C. flavida*, these bracteoles are not stipitate-glandular in the few flowering specimens seen. *Crataegus flavida* further differs in its yellow to ruddy fruit color and smaller, differently-shaped leaves, usually broadest in the middle or somewhat beyond. The very rare *Crataegus aboriginum* Sargent from near Montreal is another similar form, differing in its larger leaves (5—6 cm) and in having the larger bracteoles stipitate-glandular and the sepals deeply glandular-serrate. These features were also noted by Kruschke (1965).

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Kruschke, E.P. 1965. Contributions to the taxonomy of *Crataegus*. Milwaukee Public Mus. Public. Bot. 3: 1-273.

## ROSA SHERARDII DAVIES, AN OVERLOOKED SPECIES IN VERMONT AND NEW TO NORTH AMERICA

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### ABSTRACT

Documentation is provided for the historical and current distribution of *Rosa sherardii* Davies, a European species of sect. *Caninae* (dog-roses) that has only recently been reported for North America. Its known distribution is confined to east-central and northeastern Vermont and it is conjectured that it was introduced to the area by early settlers from Scotland. Its identification is discussed and illustrations are provided.

**KEY WORDS:** *Rosa sherardii*, Vermont, adventive

Haines (2011) recently reported Sherard's downy rose (*Rosa sherardii* Davies) from North America, stating that it occurred in Vermont. The report was based on specimens collected or annotated by the current author and joint field visits. This was the first report of this European dog rose species for North America and the purpose of the current article is to present information on the species and its presence on this continent. The species will be treated fully by Dr. Walter Lewis in the Flora of North America.

During fieldwork and review of herbarium specimens for the proposed New Flora of Vermont project, a distinctive rose was encountered that was not readily identified using standard keys and manuals for northeastern North America. Study of European literature (Kláštenský 1968; Graham & Primavesi 1993) indicated that this entity was *Rosa sherardii*, and it is now known from a number of sites in four counties in Vermont (Fig. 1). It is not known to occur elsewhere in elsewhere in North America (Walter Lewis, pers. comm.).

Specimens examined. VERMONT. Orleans Co.: Troy: Near Great Falls of the Missisquoi River, 7 Aug 1983, *Zika 7525a* (VT). Irasburg: roadside pullout, Vt. Rte. 14 S of the village of Irasburg, 2 Aug 2007, *Gilman 07110* (VT). Caledonia Co.: Peacham: along hedgerow and roadside, old hill farm country, East Hill Road, 21 Aug 2005, *Gilman 05150* (VT); Hardwick: field edge, bank of Lamaille River, Rte. 15 ca. 1.5 E of the village of Hardwick, 21 July 2009, *Gilman 07091* (VT). Groton: under powerlines, Pine Hill Wildlife Management Area, near Topsham Road, 13 June 2010, *Gilman 10029* (VT). Washington Co.: Cabot: high land overlooking Joe's Pond, Joe's Pond Road, 13 Sep 2009, *Gilman s.n.* (VT). Calais: 15 Sep 1969, *D. Franklin s.n.* (LSC). Calais: 13 Sep 1969, *Seymour 27,205 & Dudey* (VT). Marshfield: near junction of Vt. Rte. 232 and Peacham Pond Road, 9 Aug 1999, *Gilman 99138* (VT, NEBC); same location, mature fruit, 30 Aug 2003, *Gilman 99138* (VT). Plainfield: roadside, Middle Road just N of intersection with Gonyeau Road, 27 Aug 2010, *Gilman 10124* (VT). Windsor Co.: Bridgewater: 16 July 2001, *Atwood 6315* (VT). West Windsor: old pasture/hedgerow, near Spear Cemetery Road, not near dwellings, 8 Aug 2005, *Gilman 05098* (VT). Woodstock: Prosper, 28 Aug. 1920, *C.McK. Mack* 16 June 1921 and *E.M. Kittredge* 998 and (Herb. Billings-Kittredge).

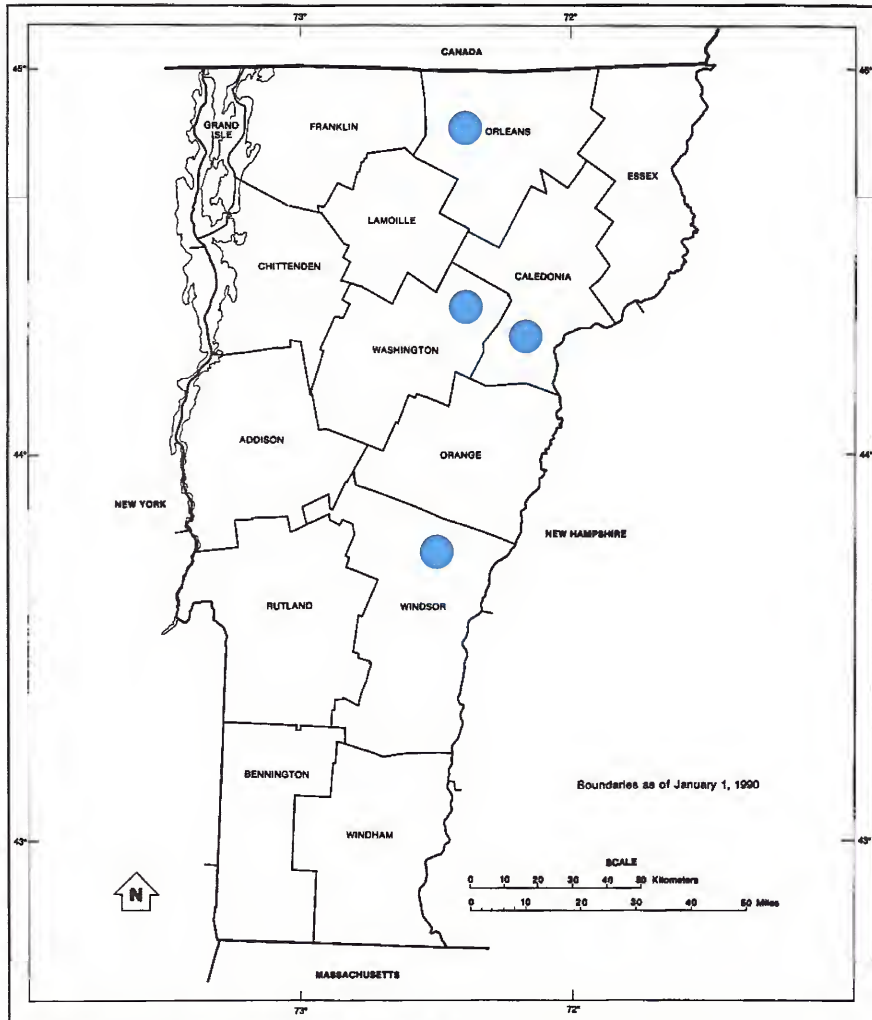


Figure 1. Distribution of *Rosa sherardii* in Vermont; placement of dots within counties shows centers of observed abundance and collections.

*Rosa sherardii* Davies (1813) is a European species of sect. *Caninae* DC ex Ser., first described from Anglesy, Wales, UK. Smith (1800) had mentioned it as a variety of *R. villosa* L., the "apple rose," and in his diagnosis, Davies segregated it from *R. villosa* as follows: "The spines of the branches are larger and more bent; the flowers more numerous, and frequently in the form of an umbel; the fruit smaller, more globular, glossy, and without bristles." It is widespread in northern Europe where it is known from the British Isles east through Scandinavia, Germany, and Poland to



Bulgaria (Kláštenský 1968), while *Rosa villosa*, also long known as *R. pomifera* Herrm., has a more southern distribution in Europe and is further distinguished by having, on average, larger leaves and more pubescence (Kláštenský 1968). Early nomenclature in this group of roses is confused, but Smith (1824, pp. 379–380) specifically stated that his (1800) concept of *R. villosa* was “the common Apple Rose, single or double, of our gardens ... [which] is not found wild in England.” Therefore, Davies’s diagnosis can be taken at face value, not in relation to some other English downy rose. In cladograms based on molecular (AFLP) analyses (Koopman et al. 2008, Figs. 1, 2), *R. sherardii* does not cluster closely with *R. villosa*.

*Rosa sherardii* is unlike any other rose occurring in New England. It forms an arching-erect, tall (ca. 1.5–2 m), loosely patch-forming shrubs with large, bluish-green, moderately but not densely pubescent leaves and single, medium-pink flowers that are ca. 5 cm in diameter (Fig. 2). The best characters for recognition are the presence of reddish-brown, sessile glands with a resinous scent on the abaxial leaf surfaces and large, bright scarlet, plumply ellipsoid to globose hips that are glabrous to only sparsely stipitate-glandular. In anthesis, the style-orifice at the summit of the hypanthium is wide, about 1/3 the diameter of the summit, and the pubescent stigmas collectively form a low dome. A noticeable feature of a vigorous plant in flower or fruit is that the inflorescences are often subtended by sylleptic growth. Although inflorescences in *Rosa* are usually terminal on branches of the new year (Kalkman 2004), in syllepsis a lateral bud below the inflorescence grows into a leafy shoot that surpasses the inflorescence. *Rosa sherardii* is especially conspicuous in autumn when fruit is ripe (Fig. 3) and its leaves have fallen — no other rose in our region has such large, conspicuous fruits except *Rosa rugosa* Thunberg.

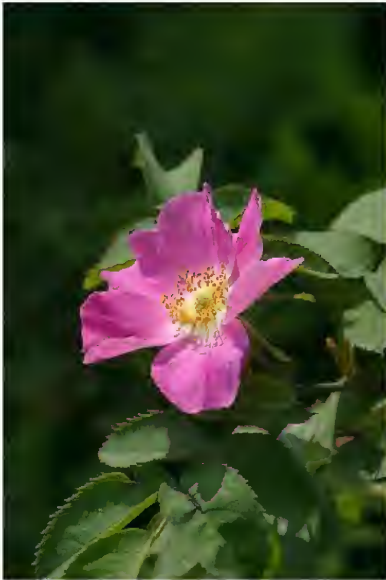


Figure 2. *Rosa sherardii* in bloom; note bluish-green leaves.



Figure 3. Hips of *Rosa sherardii*.



Figure 4. *Rosa sherardii*. Note that the hips, plumply ovate in life, dry to a nearly globose shape and often split when pressed; also note the sylleptic branch that exceeds the infructescence, a common circumstance in this species.

In comparison with locally cultivated *Rosa villosa*, *R. sherardii* plants seen in Vermont have leaves that are slightly smaller and that are much less pubescent on the abaxial leaf surfaces and have hips that are less glandular-hispid and that are typically more orange-red (scarlet) than red. The hips are, however, as large as those of cultivated *R. villosa*, contra Davies's original description that the hips are smaller. According to Graham and Primavesi (1993), "there appears to be more regional variation in *R. sherardii* than in most British wild roses," which may account for this discrepancy.

Few published illustrations of *Rosa sherardii* are available and only the one in Graham and Primavesi (1993, p. 121) fully shows diagnostic characters. Images published on the Web should be considered unreliable in identification.

Sherard's downy rose forms small, loose thickets and occurs primarily along roadsides, along old stone walls, in hedgerows, and in abandoned pastures in northeastern Vermont (Fig. 1). The general landscape where it occurs can be described as the "old agricultural" landscape of hilly, rural Vermont — where local dirt roads, stone walls, small fields, and widely-spaced houses and homesteads, along with intervening forests and woodlots, reflect two hundred years of agricultural use and rural life. The distribution of this species on the landscape indicates that it is reproducing by seed and, while confined to settled areas, most plants are not near old house foundations or actual homesteads. This pattern of distribution indicates that it has been present as an escape from cultivation for some time in northeastern Vermont (Orleans, Caledonia, and Washington counties). In Windsor County, its presence was noted (erroneously as *R. tomentosa* Sm.) by Kittredge (1931), who stated on her specimen (*Kittredge 998 & Mack*), "This rose is found on many of the way hillside and pastures in Woodstock, Pomfret, and Barnard." That this earliest collection (ca. 1920-1921) should be from Woodstock is doubtless due to botanical effort rather than absence of the species elsewhere, as Kittredge was specifically hired to document the flora of the town (Kittredge 1928).

The best explanation for the presence of this rose in a limited region of northern New England is that was intentionally brought by people for ornament, herbal use, or sentiment. Rehder (1940) indicated that *Rosa sherardii* was cultivated in North America since 1933 (probably at the Arnold Arboretum near Boston) but no current US sources for it are known to me, so it seems unlikely to have been available in trade. It seems more likely that it was brought to the area for herbal use or for sentimental reason but, even so, its restriction to a small area that was settled relatively late (ca. 1770's-1850's) seems unusual. Most of Vermont was settled from southern New England, where the species is not recorded and if it had originated from there, it would now likely be more widespread throughout Vermont.

A small section of northeastern Vermont, however, was settled directly from Scotland in 1774-1775 (Crockett 1938). The Scotch-American Company settled as many as 40 settlers from Renfrewshire in the Caledonia County town of Ryegate by October 1774 and the neighboring town of Barnet had settlers from Perth and Sterling soon after (op. cit.). These areas in Scotland are well within the range of *Rosa sherardii* (Graham & Primavesi 1993) and I conjecture that plants, cuttings, or seeds were brought by these early settlers, or perhaps later by their families, directly from Scotland to Vermont. Such an occurrence is known — the Simpson family East Craftsbury in Orleans County is stated (Carty 1952) to have brought a white rose (of unknown identity) with them from the area of Glasgow, Scotland. The presence of Sherard's downy rose in Windsor County (some 50 miles distant) is not as easily accounted for but the general landscape and rural agricultural patterns are similar to those of the more northern counties, and the species may have passed from hand to hand among the settlers and early descendants. It does not seem, however to have entered widely into gardening traditions in the region. Kittredge mentioned that some large-hipped roses, such as the one she reported (1931) as *R. tomentosa*, were removed from the landscape to local gardens, but I have not observed any plantings in local gardens or cemeteries, and the current place of *R. sherardii* in the

landscape seems to be largely non-anthropogenic. There is a minor folk use by herbalists and rural residents who gather ripe hips for tea, often drying them for use through the winter.

Reports of *Rosa tomentosa* Sm. from Vermont (e.g. Dole 1937; USDA, NRCS 2012) are apparently based ultimately on Kittredge's (1931) publication. The specimens (listed above) on which Kittredge's (1931) report was based were originally determined as *R. tomentosa* by P.A. Rydberg at the New York Botanical Garden, but they do not display the dense pubescence and very glandular hips of that species. *Rosa tomentosa* should be excluded from the flora of Vermont.

#### ACKNOWLEDGEMENTS

I thank the curators of VT, LSC, NEBC, and the Billings-Kittredge Herbarium, which is housed at the Marsh-Billings-Rockefeller National Park in Woodstock, Vermont, for providing access to specimens. Dr. Walter Lewis of Washington University in St. Louis examined collections, accompanied me on a field trip to study *Rosa sherardii* in Washington and Caledonia counties, and commented on the text. Arthur Haines and David Werier also provided valuable comments on the text, and Bill Brumback provided access to certain horticultural literature. Local residents Norman Kennedy, Gail Africa, and Greg Williams provided information about folk use in Scotland and Vermont.

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## STUDIES OF NEOTROPICAL COMPOSITAE—VI. NEW SPECIES OF EUPATORIEAE FROM BELIZE, HISPANIOLA, AND PERU

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### ABSTRACT

*Ageratina nubicola* Pruski & Clase, sp. nov., from Hispaniola, *Fleischmannia mayana* Pruski, sp. nov., from Belize, and *Mikania holmesiana* Pruski, sp. nov., from Peru are described and compared to their closest relatives. The genus *Carminatia* Moc. ex DC. is newly reported in Honduras.

**KEY WORDS:** *Ageratina*, Andes, Asteraceae, Belize, *Carminatia*, Central America, Cerro Tayu, Compositae, Cuba, Dominican Republic, Eupatorieae, *Fleischmannia*, Greater Antilles, Guatemala, Haiti, Hispaniola, Honduras, Jamaica, Maya Mountains, Mexico, *Mikania*, Peru, Rio Cenepa, South America, West Indies.

The following new species of *Ageratina* Spach, *Fleischmannia* Sch. Bip., and *Mikania* Willd. (Eupatorieae) were each encountered either during routine determination efforts or while filing herbarium specimens. Each novelty described herein is positioned in a genus validated legitimately in the 1800s, although of these three genera only consistently 4-flowered monolithic *Mikania* has been recognized continuously since its inception (King & Robinson 1987). Although *Ageratina* and *Fleischmannia* were resurrected more than four decades ago (King & Robinson 1970a, 1970b) and differ from *Eupatorium* L. by glabrous style bases, they are nevertheless still usually thought of as segregates of the Linnaean genus. Perhaps not coincidentally, each of the novelties belongs to a very speciose genus — *Ageratina* having about 280 species, *Fleischmannia* about 95 species, and *Mikania* about 430 species.

**AGERATINA NUBICOLA** Pruski & Clase, sp. nov. Figs. 1–3. **TYPE:** DOMINICAN REPUBLIC. Santiago, Municipio San José de Las Matas: Cordillera Central, comunidad Mata Grande, Loma La Hamaca, Parque Nacional Armando Bermúdez, 2500–2600 m, 2 Dec 2001, T. Clase, R. Ramírez, M. Pérez, & M. Calzada 3188 (holotype: MO; isotype: JBSD).

Fruticosa circiter 1.8 m alta; caules hexagoni distale valde hispidotomentosi vix resinosi, folia opposita petiolata, lamina 2.5–4.5 × 1.3–2.5 cm elliptico-ovata pinnatum venosa serrulata vel crenulata supra glabra subtus valde sericeo-tomentosa, capitulescentia 3–5 × 5–6 cm dense corymbiformi-paniculata, pedunculi 1–3 mm longi, capitula discioida 4.3–5.3 mm alta, involucrem campanulatum 2.5–3.5 mm diam., phyllaria 2-seriata subimbricata subaequalia 5–6, 2–3 × 1–1.5 mm valde hispidotomentosa; flosculi disci 5–8; corollis 2.5–3 mm longis infundibuliformis, tubo glandulifero, lobis 0.5–0.7 mm longis, cypselae 1.6–2 mm longae, setae pappi 2.5–3 mm longae.





Figure 1. *Ageratina nubicola* Pruski & Clase. Photograph of an isotype showing the pinnately veined discoloured leaves sericeous-tomentose abaxially and the densely hispid-tomentose stems, peduncles, and phyllaries. (Clase *et al.* 3188).



**Shrubs** ca. 1.8 m tall; stems hexagonal, faces 1-striate between costae, densely hispid-tomentose to proximally densely hirtellous, sometimes very slightly resinous, leafy at anthesis, internodes about half as long as leaves; herbage with simple trichomes, never stipitate-glandular, trichomes antrorse or those of capituloescence branchlets and peduncles often patent. Leaves opposite, petiolate; blade  $2.5\text{--}4.5 \times 1.3\text{--}2.5$  cm, elliptic-ovate, thickly chartaceous or subcoriaceous, pinnately veined, 7–9 straight to slightly curving main secondaries per side diverging from midrib at ca.  $45\text{--}55^\circ$ , veins not obviously impressed adaxially, surfaces discolorous, adaxial surface green, glabrous, glutinous, abaxial surface ochraceous, densely sericeous-tomentose, base obtuse, margins serrulate to crenulate with 5–11 teeth per side, apex acute; petiole  $0.4\text{--}0.7$  cm long, densely hispid-tomentose. **Capituloescence**  $3\text{--}5 \times 5\text{--}6$  cm, terminal, tightly corymbiform-paniculate, broadly rounded on top, slightly exserted from subtending leaves, few-bracteolate, branchlets densely hispid-tomentose, bracteoles  $1\text{--}3$  mm long, lanceolate, densely hispid-tomentose; peduncles  $1\text{--}3$  mm long, densely hispid-tomentose. **Capitula** discoid,  $4.3\text{--}5.3$  mm tall; involucre campanulate,  $2.5\text{--}3.5$  mm diam., much shorter than florets; phyllaries 2-seriate, subimbricate, subequal to slightly unequal,  $5\text{--}6$ ,  $2\text{--}3 \times 1\text{--}1.5$  mm, elliptic-ovate or outer 1 or 2 elliptic-lanceolate, spreading with age but mostly persistent, stiffly chartaceous, green throughout or distal margins purplish, densely hispid-tomentose, margins not scarious, apex acute to more commonly obtuse to rounded; receptacle flat, epaleate. **Disk florets** 5–8; corolla  $2.5\text{--}3$  mm long, funnelliform, cream-colored or pinkish, tube ca. 1 mm long, glandular, limb glabrous or lobes sometimes very slightly glandular or setulose, throat longer than lobes, lobes  $0.5\text{--}0.7$  mm long, triangular-lanceolate, inner surface of lobes papillose-mamillose; anthers  $0.7\text{--}0.8$  mm long, thecae cordate basally, auricles obtuse, anther collar cell walls (Fig. 2A) weakly beaded-thickened, both vertical and transverse endothelial cell walls (Fig. 2B) thickened irregularly, appendages about as long as wide, apex obtuse to rounded; style base cylindrical to slightly dilated, glabrous, branches ca. 1.5 mm long, appendages cylindrical, short-papillose. **Cypselae** (not fully mature)  $1.6\text{--}2$  mm long, glandular, also sparsely setose, faces and angles brownish, concolorous, gradually narrowed basally to a narrowly annular carpododium; pappus bristles many,  $2.5\text{--}3$  mm long, about as long as corollas, stramineous, scabrid-barbellate.

**Distribution and ecology.** This apparently regional endemic is known only from the type collection made at 2500–2600 meters elevation on Loma La Hamaca in the north-central Cordillera Central of the Dominican Republic (Fig. 3), about 20 kilometers north of Pico Duarte (elev. 3087 meters), the tallest mountain in the West Indies. *Ageratina nubicola* occurs in cloud forests (whence the epithet) and is known to flower in December.

*Ageratina* was included within a broadly defined *Eupatorium* by Bentham and Hooker (1873) and Robinson (1913). The Colombian species of *Ageratina* were spread variously among *Eupatorium* sections *Subimbricata* and *Eximbricata* in the key of Robinson (1918). Greene (1903) was the first to circumscribe *Ageratina* in the broad modern sense (King & Robinson 1970b) and including both temperate and tropical elements, but he did so under *Kyrstenia* Necker. However, Necker's *Elementa Botanica* is listed in the Code (Appendix VI) as an oppressed work, rendering his *Kyrstenia* invalid and *Ageratina* as the earliest available generic name. Although Coulter (1895) described *Mallinoa* J.M. Coul. and *M. corymbosa* J.M. Coul. (synonyms, respectively, of *Ageratina* and *A. muelleri* (Sch. Bip. ex Klatt) R.M. King & H. Rob., fide King & Robinson 1987) eight years before Greene's work, Coulter was misled by what he interpreted as sagittate anther thecae bases (the thecae bases are actually cordate fide Robinson 1913) and doubtfully ascribed his monotypic *Mallinoa* to tribe Inuleae, his genus approaching Greene's conglomerate in neither species numbers nor clarity.

The species of *Ageratina* from Hispaniola were treated by Liogier (1996) within a broadly defined *Eupatorium*, but *Ageratina* differs most notably by its phyllaries subequal or nearly so and by its glabrous style base. Among species of *Ageratina* from Hispaniola, *A. nubicola* by its pinnately

veined leaves resembles *A. dictyonera* (Urb.) R.M. King & H. Rob., *A. illita* (Urb.) R.M. King & H. Rob., and *A. urbana* (Ekman ex Urb.) R.M. King & H. Rob. *Ageratina nubicola* differs from both *A. dictyonera* and *A. illita* by discolorous (vs. concolorous) leaves densely tomentose (vs. glabrous or glutinous) abaxially and from *A. urbana* by distally densely hispid-tomentose (vs. glabrous to puberulent), weakly or non-resinous (vs. resinous) stems, densely hispid-tomentose (vs. glabrous) phyllaries, and glandular and sparsely setose (vs. glabrous) cypselae. As an aid to identification of *A. nubicola*, we provide below a key to Hispaniolan species of *Ageratina*.

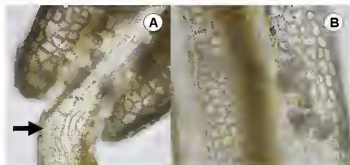


Figure 2. *Ageratina nubicola* Pruski & Clase. Photographs of anthers and their cellular details. A. Anther base showing cordate thecae with obtuse auricles and weakly beaded-thickened cell walls (arrow) of the anther collar. B. Endothelial tissue showing irregularly thickenings on both the vertical and transverse cell walls. (Clase et al. 3188)

#### Key to the species of *Ageratina* known or expected in Hispaniola

1. Leaf blades 3-nerved from near base.
  2. Peduncles stipitate-glandular (Mexico, weedy in Jamaica, South America, southern Europe, and the paleotropics, expected in Hispaniola) *Ageratina adenophora* (Spreng.) R.M. King & H. Rob.
  2. Peduncles not stipitate-glandular (Bahamas, Mexico, and in the Greater Antilles in Cuba and Hispaniola) *Ageratina havanensis* (Kunth) R.M. King & H. Rob.
1. Leaf blades pinnately veined.
  3. Leaf surfaces concolorous, glabrous or glutinous abaxially.
    4. Leaves lanceolate to oblanceolate, cypselae glandular, setulose (Dominican Republic and Haiti) *Ageratina dictyonera* (Urb.) R.M. King & H. Rob.
    4. Leaves elliptic to elliptic-ovate, cypselae glandular, otherwise glabrous (Dominican Republic and Haiti) *Ageratina illita* (Urb.) R.M. King & H. Rob.
  3. Leaf surfaces discolorous, densely tomentose abaxially.



5. Stems densely hispid-tomentose to proximally densely hirtellous, weakly or not resinous; leaf base obtuse, margins serrulate to crenulate with 5–11 teeth per side; phyllaries densely hispid-tomentose; cypselae glandular and sparsely setose (Dominican Republic)

..... ***Ageratina nubicola*** Pruski & Clase

5. Stems glabrous to puberulent, resinous; leaf base broadly obtuse to rounded, margins serrate to crenate with 15–30 teeth per side; phyllaries glabrous; cypselae glabrous (Haiti)

..... ***Ageratina urbanii*** (Ekman ex Urb.) R.M. King & H. Rob.

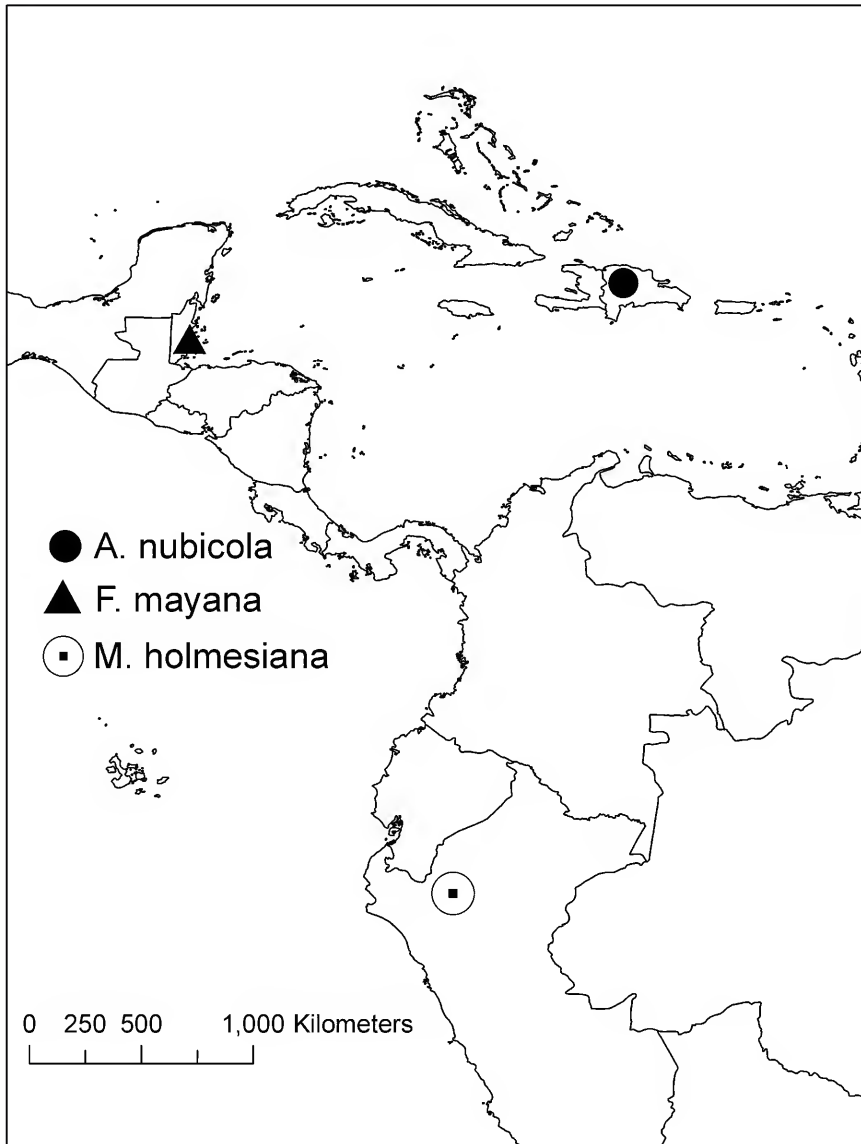


Figure 3. Distribution map showing localities of *Ageratina nubicola* Pruski & Clase (dot), *Fleischmannia mayana* Pruski (triangle), and *Mikania holmesiana* Pruski (bulleted circle).

**FLEISCHMANNIA MAYANA** Pruski, sp. nov. Figs. 3–6. **TYPE:** BELIZE. Western slope of Victoria Peak in the Cockscomb Range of the Maya Mountains, steep rock face, 16° 48' 43" N, 88° 37' 14" W, 1080 m, 18 Nov 2006, S.W. Brewer & M. Pau 3349 (holotype: MO; isotypes: BRH, NY).

Herba procumbens usque 30 cm alta inferne foliata; caules subglabri; folia opposita petiolata, lamina 4–7 × 5–9 mm pedata 3–7-lobata basalter 3-nervata supra sparse hirsuto-pilosa subtus glandulosa subglabra, petiolo 3–7 mm longo; capitulescentia laxa cymosa; pedunculi 7–20(–35) mm longi; capitula discoidea 5–6 mm alta; involucrem campanulatum 5–7 mm diam.; phyllaria 2–3-seriata subimbricate aliquantum gradata 2–3 × 1.5–2 mm oblonga glabra, flosculi disci 23–30, corollis 2.2–2.3 mm longis campanulatis, tubo 0.5–0.6 mm longo valde nervato, lobis 0.4–0.5 mm longis deltatis frequenter pauciglandulosis, cypselae 1.2–1.3 mm longae, setae pappo 8–11, 1.4–1.7 mm longae haud contiguata.

**Delicate procumbent perennial epipetric herbs** rooting at the proximal nodes, with ascending apices, procumbent portion 5–20 cm long, moderately leafy with internodes 0.5–2.2 cm long, ascending portions 15–30 cm tall, unbranched below capitulescence, remotely leafy, internodes 3–8 cm long; stems subglabrous, subterete, striate. **Leaves** opposite, petiolate; blade (Fig. 5A, E) 4–7 × 5–9 mm, pedate, deltate in outline, chartaceous, 3–7-lobed, 3-nerved from very base, the lateral veins usually dichotomous near base, base subtruncate to subcordate, margins broadly and obtusely lobed about 1/3–1/2 of the distance to midrib, lobes to ca. 2 mm long, each proximal marginal primary lobe often shallowly 2-parted and more or less directed laterally, central lobe often shallowly 3-parted and lobules more or less directed forward, adaxial surface sparsely hirsute-pilose, abaxial surface glandular, otherwise subglabrous; petiole 3–7 mm long. **Capitulescence** 4–7 × 3–5 cm, openly and laxly cymose, 3–11-capitulate, held well above subtending leaves on basically unbranched leafless stalks, ultimate branches few, subequal; peduncles 7–20(–35) mm long, sparsely hirsutulous-pilosulose, 1–3-bracteolate, bracteoles 1.5–3 mm long, linear-lanceolate. **Capitula** discoid, 5–6 mm tall; involucre campanulate, 5–7 mm diam.; phyllaries 12–18, primary phyllaries 2–3-seriate, subimbricate to sometimes nearly eximbricate, subequal to slightly graduated with the outer > 1/2 as long as the inner (Fig. 5B), 2–3 × 1.5–2 mm, oblong, chartaceous-scarious, bicostate proximally, glabrous, apex obtuse to rounded, a few narrow irregularly disposed ascending to spreading outer phyllaries also typically present; receptacle convex, epaleate. **Disk florets** 20–23; corolla 2.2–2.3 mm long, campanulate (Fig. 5C), white (Fig. 5F), glabrous or lobes usually sparsely glandular, tube 0.5–0.6 mm long, dilated at base, thickly ribbed, limb abruptly ampliate, lobes 0.4–0.5 mm long, deltate, veins intramarginal, faint, minutely papillose-roughened within; anthers ca. 0.5 mm long, anther collar cell walls (Fig. 6B) densely annulated (transversely banded), both vertical and transverse endothelial cell walls thickened irregularly, apical appendage (Fig. 6A) slightly broader than long, obtuse to broadly rounded at apex; style base cylindrical, glabrous, trunk glabrous, branches 1.3–1.5 mm long, appendage slightly clavellate. **Cypselae** 1.2–1.3 mm long, shorter than corollas, 5-ribbed, faces and ribs concolorous, black (Fig. 5D) at maturity, glabrous or sometimes sparsely glandular apically, carpodium ca. 0.1 mm long, stopper-shaped with distinct distal rim, stramineous; pappus of 8–11 persistent bristles, 1.4–1.7 mm long, slightly unequal with a few slightly shorter, non-contiguous at base (Fig. 5D), reaching to about base of corolla lobes, stramineous, scabridulous, narrow apically.

**Distribution and ecology.** This narrow endemic is known only from the type collection made at 1080 meters elevation on moderately steep rock faces in full sun in the Maya Mountains (whence the epithet) in Belize (Fig. 3). *Fleischmannia mayana* is known to flower only in November and was seen only once during the extensive field work of Steven Brewer, who kindly submitted for identification his collection to the first author.



Figure 4. *Fleischmannia mayana* Pruski. Photograph of an isotype showing the procumbent stems with leaves mostly proximal. (Brewer & Pau 3349).

*Fleischmannia*, by virtue of its type having a pappus of 5 bristles only, was recognized by Bentham and Hooker (1873) and Robinson (1906, 1913) as distinct from *Eupatorium*. Bentham and Hooker (1873) and Robinson (1906, 1913), however, recognized *Fleischmannia* as containing only two species, whereas King and Robinson (1970a) transferred 50+ species from *Eupatorium* to a restructured *Fleischmannia*. Although *F. rivulorum* (B.L. Rob.) R.M. King & H. Rob., the generic disposition of which Robinson (1926) said was not "entirely satisfactory," was included in the expanded *Fleischmannia* sensu King and Robinson (1970a, 1987), all species of either generic concept possess characteristic, albeit not diagnostic, strongly ribbed corolla tubes.

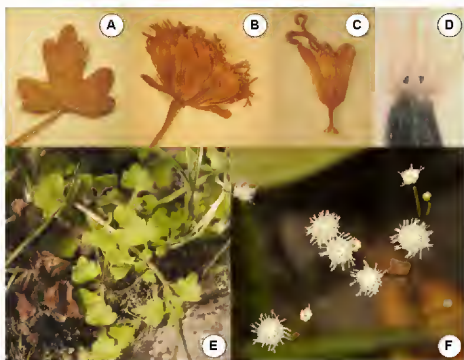


Figure 5. *Fleischmannia mayana* Pruski. A. Leaf showing lobing, venation, and glandular abaxial blade surface. B. Capitulum showing oblong subequal bicostate primary phyllaries. C. Campanulate corolla showing strongly ribbed tube. D. Cypsel showing 10 pappus bristles non-contiguous basally. E. Proximal stem leaves. F. Capitulescence from above. (A–D from an isotype, E–F field photographs taken by Steven Brewer, all from Brewer & Pau 3349)

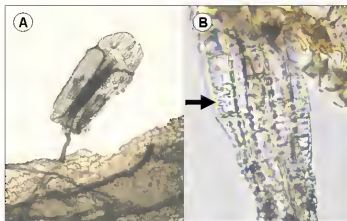


Figure 6. *Fleischmannia mayana* Pruski. Photographs of anthers and their cellular details. A. Anther showing the broad apical appendage with rounded apex. B. Densely annulated (transversely banded) cell walls (arrow) of the anther collar. (Brewer & Pau 3349)

This new species is referable to *Fleischmannia* by the thickly ribbed corolla tube character (Fig. 5C), as well as by basally non-contiguous pappus bristles (Fig. 5D), and stopper-shaped carpodia. The placement of this species in *Fleischmannia* is supported further by microcharacters of densely annulated anther collar cell walls and minutely papillose-roughened corolla lobe inner surfaces. Although in *F. mayana* the corollas (Fig. 5C) are clearly campanulate (vs. usually narrowly funnelliform) and the anther appendages (Fig. 6A) are slightly broader than long (vs. usually slightly longer than wide), thereby testing the limits of *Fleischmannia*, other technical generic features (e.g., anther collar cell walls densely annulated and stopper-shaped carpodia) are not violated.

Among the 30 or so Central American species of *Fleischmannia* (King & Robinson 1987; Robinson 1991), *F. mayana*, by its delicate herbaceous habit, lobed leaves, and laxly cymose capitulescence, keys to (Williams 1976) and vaguely recalls *F. carletonii* (B.L. Rob.) R.M. King & H. Rob. *Fleischmannia carletonii*, however, is a totally different Guatemalan and Honduran species with much larger deeply 2–3-pinnately dissected leaves with linear blade segments and cypselsae with about 20 basally contiguous pappus bristles. *Fleischmannia mayana*, by its few non-contiguous pappus bristles and lax paucicapitulate cymose capitulescences, resembles the generic type *F. arguta* (Kunth) B.L. Rob., but *F. mayana* differs by many features not the least of which are the much longer never stipitate-glandular peduncles, fewer and oblong phyllaries, and the campanulate corollas. Balick et al. (2000) listed three species of *Fleischmannia* occurring in Belize, and among them *F. blakeri* (B.L. Rob.) R.M. King & H. Rob. is similar to the new species in habit and habitat preferences, but not overly similar otherwise. Other Central American openly corymbiform perennial *Fleischmannias* all are larger plants and basically have non-lobed lanceolate to ovate leaves, thereby differing from *F. mayana*. Representative species of this group, e.g., *F. imitans* (B.L. Rob.) R.M. King & H. Rob. and *F. sideritides* (Benth.) R.M. King & H. Rob., are often epipetric rhyacophilous herbs, and it is perhaps no coincidence that *F. mayana* too is epipetric.

**MIKANIA HOLMESIANA** Pruski, sp. nov. Figs. 3, 8. TYPE: PERU. Amazonas. Bagua. Dtto. Imaza: Quebrada Almendra, Cerro Tayu, 5° 15' 56" S, 78° 22' 07" W, 1200 m, 20 Jul 2004, R. Rojas, R. Vasquez, & R. Apam 3165 (holotype: MO; isotypes: BAYLU, USM).

Plantae volubiles, caules dense pubescentes vel dense villosi, folia opposita petiolata, lamina 2.5–6.3 × 1.3–2.9 cm lanceolata vel lanceolato-ovata glandulosa, supra pubescentia subtus dense villosa, capitulescentia 5–9 × 8–10 cm corymbiformi-paniculata capitula ternata sessilia vel subsessilia, capitula discoidea 7–8 mm alta, involucrem cylindricum circiter 2 mm diam., phyllaria 4–5 × 0.8–1.1 mm lanceolata, bractea subinvolucris 3–5 × 1–1.8 mm spatulata vel oblonga, flosculi disci 4, corollis 3.4–3.9 mm longis anguste campanulatis, lobis 1.1–1.2 mm longis late lanceolatis, stylis rami longe papillosi, cypselsae 4–5 mm longae, setae pappi 3–5–4.5 mm longae.

**Herbaceous perennial vines to lianas;** stems subterete, densely crisped pubescent to densely villous, pith solid. Leaves opposite, petiolate; blade 2.5–6.3 × 1.3–2.9 cm, lanceolate to lanceolate-ovate, stiffly chartaceous, venation arching pinnate from well above base with 1 or 2 pairs of stronger secondary veins usually reaching at least to mid-blade, both surfaces punctate-glandular, the adaxial surface also crisped pubescent, the abaxial surface also densely brownish villous, the base broadly cuneate to obtuse, never decurrent, the margins entire, the apex acute; petiole 0.3–1.3 cm long. **Capitulescence** 5–9 × 8–10 cm, terminal, corymbiform-paniculate and round on top, central axis and branchlets densely crisped pubescent to densely villosulous, ultimately of ternate clusters of sessile or subsessile capitula; peduncles (when present subtending some lateral capitula) to ca. 1(–2) mm long, densely crisped pubescent. **Capitula** discoid, 7–8 mm tall; involucre cylindrical, ca. 2 mm diam., commonly large-bracteate or subinvolucrate; phyllaries 4, 4–5 × 0.8–1.1 mm, in fruit reaching only to the corolla tube, lanceolate, stiffly chartaceous, apices obtuse to rounded, the outer 2 phyllaries crisped-puberulent to villosulous, the inner 2 crisped puberulent medially or distally; subinvolucral



bract 1 per capitulum, ascending,  $3-5 \times 1-1.8$  mm,  $1/2$  the length to as long as involucre, spatulate to oblong, herbaceous, apex acute to obtuse, abaxial surface crisped-puberulent to villosulous, also sparsely punctate-glandular. Disk florets 4; corolla  $3.4-3.9$  mm long, well-exserted (at least in fruit) from involucre, shorter than mature fruits, narrowly campanulate, sparsely setulose at tube-throat juncture and on lobe apex, tube  $1.1-1.2$  mm long, never longer than the limb, throat  $1.2-1.5$  mm long, lobes  $1.1-1.2$  mm long, broadly lanceolate, erect, slightly shorter than to about as long as the throat; anthers  $1.5-1.6$  mm long, stramineous, rounded basally; style branches to ca. 2 mm long, appendage long-papillose, papillae  $0.05-0.1$  mm long, nectary annular,  $0.2-0.3$  mm long. Cypselae  $4-5$  mm long, at maturity about as long as phyllaries, thus the persistent corolla then almost fully exserted from involucre, sparsely setulose to subglabrous; pappus bristles many,  $3.5-4.5$  mm long, usually slightly shorter than the cypselae, pale brown.

Paratypes: PERU. Amazonas. Bagua. Dtto. Imaza: Tayu Mujaji, Comunidad de Wawas, vegetación pequeña hasta 1.5 m de alto, 900 m, 23 Oct 1997, Vásquez, Awanash, & Pitug 24677 (MO); Tayu Mujaji, bosque primario, 900–1030 m, 17 Feb 2002, Vásquez 27609 (MO).

Distribution and ecology. *Mikania holmesiana* is a vine known only from three collections (two of these basically sterile) from 900–1200 meters elevation on the upper slopes and summit of Cerro Tayu (Tayu Mujaji), an isolated sandstone mountain in Dpto. Amazonas in northern Peru (Fig. 3). *Mikania holmesiana* is known to be in late flower and early fruit in July and appears to grow on rocky soil.

Etymology. It is truly a pleasure to name *Mikania holmesiana* for my (jp) good friend and native Louisianan (Holmes 1990b) Dr. Walter C. Holmes, the world authority on taxonomy of *Mikania*. Walter was party to the naming of *M. pruskii* H. Rob. & W.C. Holmes and is very deserving of being commemorated similarly. *Mikania holmesiana* is validated herein so that the name may be used in Walter's revision of *M. guaco-parviflora* species group, which he has otherwise completed.

*Mikania*, recognized by its 4-flowered capitula and its usually vining habit, is an American-centered genus of about 430 species, with 350+ species being South American endemics. The Peruvian species of *Mikania* were revised by Holmes and McDaniel (1982), who recognized 75 species. More recently, Pruski (2010) credited 88 species of *Mikania* to Peru. *Mikania holmesiana* is described from sandstone Cerro Tayu in the eastern Andes of northern Peru, immediately outside the region covered by Pruski (2010), raising to 89 the number of Peruvian Mikanias counted by the first author.

*Mikania holmesiana* fits well within the *M. guaco-parviflora* species group originally circumscribed by Robinson (1922a), a group recognized by sessile temately disposed capitula (Fig. 7A–C) and long-papillose style branch appendages (Walter Holmes, pers. comm.). Indeed, in the treatments of Peruvian Mikanias by Holmes and McDaniel (1982) and Pruski (2010), *M. holmesiana* keys to the *M. guaco-parviflora* species group. Species of this group are routinely keyed out together, as done elsewhere by Robinson (1922b), Holmes (1990a), Pruski (1990, 1997, 2002), and Robinson and Holmes (2008). Within this species group, *M. holmesiana* seems most similar by its large broad subinvolute bracts more than half as long as the phyllaries to *M. trinitaria* DC. and especially to *M. parviflora* (Aubl.) H. Karst., but it differs from each in herbage vestiture and floral details.

*Mikania parviflora* is remarkably consistent morphologically throughout its range, having stems subglabrous to puberulent with subappressed trichomes, adaxial leaf surfaces glabrous or nearly so, deltate corolla lobes much shorter than throat, and fruits included within the involucre. Hurtado & Alvarado 496, referred to *M. parviflora* by Robinson and Holmes (2008) by ternate large-bracteate

capitula and deltate corolla lobes, has hirsute vestiture and is on the periphery of *M. parviflora*'s sphere, it too perhaps represents yet another undescribed taxon. *Mikania holmestiana* differs from *M. parviflora* (and from *Hurtado & Alvarado 496* as well) by its densely pubescent herbage with crisped trichomes, lanceolate corolla lobes nearly as long as the throat, phyllaries 4–5 (vs. 6–8) mm long, mature fruits often longer than corollas and about as long as phyllaries, and by corollas well-exserted (at least in fruit) from involucre. Additionally, *M. parviflora* is centered in Amazonia where it occurs mostly at low elevations (Pruski 1997), whereas *M. holmestiana* occurs at 900–1200 meters elevation in the eastern Andes. *Mikania holmestiana* thus sticks out like a sore thumb from the well-delimited *M. parviflora*.

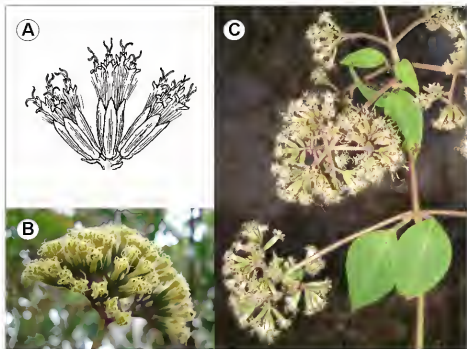


Figure 7 Representative capitulescences of the *Mikania guaco-parviflora* species group showing the ternately disposed terminal clusters of capitula. A. *Mikania guaco* Bonpl. showing small subinvolucral bracts. B. Rounded capitulescence of *Mikania guaco* showing the clusters of capitula in concentric bands (Peru, Loreto, Puente Itaya, km 56 carretera Iquitos–Nauta Pruski, Ortiz, & Amastfuen 4346). C. Lateral capitulescences of *Mikania speciosa* DC. (Peru, Pasco, Oxapampa, Cordillera Yanachaga, Quebrada San Alberto Pruski, Ortiz, Castillo, & Rivera 4393) (A from Pruski 2002, B–C field photographs taken by John Pruski).





Figure 8. *Mikania holmesiana* Pruski. Photograph of an isotype showing densely pubescent to densely villous stems, long-bracteate capitula in ternate clusters, and corollas well-exserted from involucre. (Rojas *et al.* 3165).



Another close congener of *M. holmesiana* with moderately large-bracteate capitula, found among species in the long-lobed corolla lead in the keys to the *M. guaco-parviflora* species group in Robinson (1922a), Holmes and McDaniel (1982), and Pruski (1990, 1997) is *M. trinitaria*. *Mikania trinitaria* is a puberulent to glabrate plant with corolla lobes very much longer than the short throats, thereby clearly differing from *M. holmesiana*. Similar to *M. holmesiana* in the capitulescence structure with ultimate capitula ternately clustered and by proportionally long subinvolucral bracts are Venezuelan *M. steyermarkii* R.M. King & H. Rob. and western Amazonian (Bolivia, Brazil, Ecuador, and Peru) *M. stygia* B.L. Rob. However, each *M. steyermarkii* and *M. stygia* differs from *M. holmesiana* in vestiture of the herbage, by proportionally short corolla lobes, and by smooth to short-papillose style branches, the latter character used by Walter Holmes (pers. comm.) to technically exclude both *M. steyermarkii* and *M. stygia* from the *M. guaco-parviflora* species group.

***Carminatia recondita*** McVaugh, Contr. Univ. Michigan Herb. 9: 384. 1972. (Fig. 9).

Voucher: **HONDURAS**. Copán: Open pinares on hillside above CA11, ca. 5 km W of Ruinas de Copán and ca. 5 km E of El Florido at border with Guatemala, 14°50'23" N, 89°11'08" W, 795 m, 15 Nov 2008, Pruski, Vega, Ortiz, & Jiménez 4535 (EAP, USCG).



Figure 9. *Carminatia recondita* McVaugh. Photograph showing the nodding cylindrical capitula. (Guatemala, hillsides SSW of Lago de Amatitlán, 5 km NE of Volcán Pacaya: Pruski, MacVean, & MacVean 4505).

The three species of *Carminatia* are annual herbs and recognized by their interrupted spiciform capitulescences with clusters of narrowly cylindrical few-flowered capitula and by cypselae with a plumose pappus. While botanizing a few years ago, we collected *C. recondita* on both sides of the Guatemala-Honduras border. Neither the genus nor species, however, were reported for Honduras by McVaugh (1972), Williams (1976), King and Robinson (1987), Turner (1997), or Nelson Sutherland (2008). This marks the first report of *Carminatia* Moc. ex DC. and *C. recondita* in Honduras. Because Williams (1976) noted only *C. tenuiflora* DC. in Guatemala and because of the overall similarity among species of *Carminatia*, it seems useful to supplement this Honduran record with a field photograph (Fig. 9) showing the diagnostic nodding capitula of *C. recondita*. *Carminatia recondita* is further distinguished from *C. tenuiflora* by narrowly funnelliform corollas 0.7–1 mm diam. apically and cypselae  $\geq 5.5$  mm long (McVaugh 1972; Turner 1997). Plants of *C. recondita* at the locality in Honduras were scattered in pine forests and not at all uncommon.

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## NEWLY REQUIRED INFRAFAMILIAL NAMES MANDATED BY CHANGES IN THE CODE OF NOMENCLATURE FOR ALGAE, FUNGI AND PLANTS

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### ABSTRACT

A recent change in the botanical code that gave priority to infrafamilial names based on conserved family names now requires adoption of a series of names either unused or not yet validatedly published. Accordingly, the following new names are proposed: *Asteranthoideae* (replaces *Foetidoideae*), *Dialypetalanthaeae* (replaces *Condamineae*), *Dialypetalanthoideae* (replaces *Ixoroideae*), *Heterophyxioidaeae* (replaces *Psiloxylloideae*), *Limonieae* (replaces *Armerieae*), and *Limonioideae* (replaces *Statioideae*). The names *Bretschneideroideae*, *Cochlospermoideae*, *Cyanastroideae*, *Desfontainioideae*, *Diclidanthereae*, *Gonystyleae*, *Hoplostigmataeae*, *Hydrophyllinae*, *Julanieae*, *Malinae*, *Medusagynoideae*, *Olinioideae*, *Orchidiinae*, *Petrosavioideae*, *Rhoipteleoideae*, *Samydoideae*, *Scyphostegioideae*, *Stemonoideae*, *Tecophilaeoideae*, *Theoideae*, *Thurnieae*, *Trichopoideae* and *Xanthorrhoeoideae* are validated. All infrageneric names of conserved family names above the rank of genus are listed; such names now function as if they are conserved over earlier names of the same rank based on a non-conserved family name.

**KEY WORDS:** nomenclature, conserved family names, *Asteranthoideae*, *Bretschneideroideae*, *Cochlospermoideae*, *Cyanastroideae*, *Desfontainioideae*, *Dialypetalanthaeae*, *Dialypetalanthoideae*, *Diclidanthereae*, *Gonystyleae*, *Heterophyxioidaeae*, *Hoplostigmataeae*, *Hydrophyllinae*, *Julanieae*, *Limonieae*, *Limonioideae*, *Malinae*, *Medusagynoideae*, *Olinioideae*, *Orchidiinae*, *Petrosavioideae*, *Rhoipteleoideae*, *Samydoideae*, *Scyphostegioideae*, *Stemonoideae*, *Theoideae*, *Thurnieae*, *Trichopoideae*, *Xanthorrhoeoideae*

During the Nomenclature Session at the 2011 Botanical Congress in Melbourne a provision was proposed and supported by individuals wishing to establish *Malioideae* (1968) as an available subfamily name within *Rosaceae* instead of *Spiraeoideae* (1832), the earliest available name at that rank, for a taxon circumscribed to include the genus *Malus*. That it was necessary to then conserve *Malaceae* over *Amygdalaceae* (Gunner et al. 2011) seems to have been unknown to the supporters, and one might also assume they were equally unaware of the impact their proposal had on other names long in use and well-established in the literature. To conform to the new provision in the *Code*, the following names are established.

***Asteranthoideae*** Reveal, subfam. nov., based on *Asteranthaceae* R. Knuth in H.G.A. Engler & K.A.E. Prantl, *Pflanzenr.* 105: 1. 22 Aug 1939, *nom. cons.* – T: *Asteranthos* Desf. (1820). – *Lecythidaceae* – NOTE: This name replaces *Foetidoideae* Engl., *Syllabus*, ed. 1: 146. Apr 1892.

***Bretschneideroideae*** Reveal, subfam. nov., based on *Bretschneideraceae* Engl. & Gilg, *Syllabus*, ed. 9-10: 218. 6 Nov 1924, *nom. cons.* – T: *Bretschneidera* Hemsl. (1901). – *Akaniaceae*

***Cochlospermoideae*** Takht. ex Reveal, subfam. nov., based on *Cochlospermaceae* Planch. in London J. Bot. 6: 305. Jun-Jul 1847, *nom. cons.* – T: *Cochlospermum* Kunth, *nom. cons.* (1822). – *Bixaceae*

- Cyanoastroideae** Engl. ex Reveal, subfam. nov., based on *Cyanostraceae* Engl., Bot. Jahrb. Syst. 28: 357. 22 Mai 1900, *nom. cons.* – T: *Cyanostrum* Oliv. (1891). – Tecophilaeaceae
- Desfontainioideae** Hegnauer ex Reveal, subfam. nov., based on Desfontainiaceae Endl. ex Pfeiff., Nomencl. Bot. 1: 1037. 3 Oct 1873, *nom. cons.* – T: *Desfontainia* Ruiz & Pav. (1794). – Columelliaceae
- Dialypetalanthaceae** Reveal, trib. nov., based on Dialypetalanthaceae Rizzini & Occhioni in Lilloa 17: 253. 30 Dec 1948, *nom. cons.* – T: *Dialypetalanthus* Kuhl. (1925). – Rubiaceae – NOTE: Condamineae Benth. & Hook.f., Gen. Pl. 2: 12. 7-9 Apr 1873.
- Dialypetalanthoideae** Reveal, subfam. nov., based on Dialypetalanthaceae Rizzini & Occhioni in Lilloa 17: 253. 30 Dec 1948, *nom. cons.* – T: *Dialypetalanthus* Kuhl. (1925). – Rubiaceae – NOTE: This name replaces Ixoroideae Raf. in Ann. Gén. Sci. Phys. Bruxelles 6: 84. 1820.
- Diclidanthereae** Reveal, trib. nov., based on Diclidanthraceae J. Agardh, Theoria Syst. Pl.: 195. Apr-Sep 1858, *nom. cons.* – T: *Diclidanthera* Mart. (1827). – Polygalaceae – NOTE: This name replaces Moutabeae Chodat in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 4: 329. Jul 1896.
- Gonystyleae** Reveal, trib. nov., based on Gonystyloideae Domke, Biblioth. Bot. 111: 33. 31 Dec 1934. – Type: *Gonystylus* Teijsm. & Binn. (1862). – Thymelaeaceae
- Heterophyxoideae** Reveal, subfam. nov., based on Heteropyxidaceae Engl. & Gilg in H.G.A. Engler, Syllabus, ed. 8: 281. Jan-Feb 1920, *nom. cons.* – T: *Heteropyxis* Harv., *nom. cons.* (1863). – Myrtaceae – NOTE: This name replaces Psiloxylodeae Schmid in Taxon 29: 559. 14 Nov 1980.
- Hoplestigmataeae** Reveal, trib. nov., based on Hoplestigmataceae Gilg in H.G.A. Engler & E.F. Gilg, Syllabus, ed. 9-10: 322. 6 Nov 1924, *nom. cons.* – T: *Hoplestigma* Pierre (1899). – Boraginaceae
- Hydrophyllinae** Reveal, subtrib. nov., based on Hydrophyllae Rchb., Fl. Germ. Excurs. 1(3): 347. Jul-Dec 1831. – Type: *Hydrophyllum* L. (1753). – Boraginaceae
- Julianieae** Reveal, trib. nov., based on Julianiaceae Hemsl., J. Bot. 44: 379. Oct 1906, *nom. cons.* – Type: *Juliania* Schldtl., *nom. illeg.* (1844, non La Llave & Lex., 1825 = *Amphipterygium* Schiede ex Standl., 1923). – Anacardiaceae
- Limonieae** Reveal, subfam. nov., based on Limoniaceae Ser., Fl. Pharm.: 456. 1851, *nom. cons.* – T: *Limonium* Mill., *nom. cons.* (1754). – Plumbaginaceae – NOTE: This name replaces Armericeae Dumort., Anal. Fam. Pl.: 27. 1829.
- Limonioidae** Reveal, subfam. nov., based on Limoniaceae Ser., Fl. Pharm.: 456. 1851, *nom. cons.* – T: *Limonium* Mill., *nom. cons.* (1754). – Plumbaginaceae – NOTE: This name replaces Statioideae Burnett, Outl. Bot.: 1028, 1095, 1101. Feb 1835.
- Malinae** Reveal, subtrib. nov., based on *Malaceae* Small, Fl. S.E. U.S.: 529. 22 Jul 1903, *nom. cons.* – T: *Malus* Mill. (1754). – Rosaceae
- Medusagynoidae** Reveal, subfam. nov., based on Medusagynaceae Engl. & Gilg, Syllabus, ed. 9-10: 280. 6 Nov 1924, *nom. cons.* – T: *Medusagyne* Baker (1877). – Medusagynaceae
- Olinioideae** Reveal, subfam. nov., based on Oliniaceae Harv. & Sond., Fl. Cap. 2: ix. 15-31 Oct 1862, *nom. cons.* – T: *Olinia* Thunb. (1800). – Penaceae
- Orchidinae** Dressler & Dodson ex Reveal, subtrib. nov., based on Orchidaceae Juss., Gen. Pl.: 64. 4 Aug 1789, *nom. cons.* – T: *Orchis* L. (1753). – Orchidaceae – NOTE: Although this name is widely used, it has yet to be validated.
- Petrosavioideae** Reveal, subfam. nov., based on Petrosavieae Engl. in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. Nachtr.: 71, 72. Jul 1897. – Type: *Petrosavia* Becc. (1871). – Petrosaviaceae
- Rhoipteleoideae** Reveal, subfam. nov., based on Rhoipteleaceae Hand-Mazz., Repert. Spec. Nov. Regni Veg. 30: 75. 15 Feb 1932, *nom. cons.* – T: *Rhoiptelea* Diels & Hand-Mazz. (1932). – Juglandaceae

- Samydoideae** Reveal, subfam. nov., based on Samydaceae Vent., *Mém. Cl. Sci. Math. Inst. Natl. France* 1807(2): 149. 1808. – Type: *Samyda* Jacq. (1760). – Salicaceae
- Scyphostegioidae** Reveal, subfam. nov., based on Scyphostegiaceae Hutch., *Fam. Fl. Pl.* 1: 229. 15 Jan 1926, *nom. cons.* – Type: *Scyphostegia* Stapf (1894). – Salicaceae
- Stemonioideae** Reveal, subfam. nov., based on Stemonaceae Caruel, *Nuovo Giorn. Bot. Ital.* 10: 94. Apr 1878, *nom. cons.* – Type: *Stemona* Lour. (1790). – Stemonaceae
- Tecophilaoideae** Reveal, subfam. nov., based on Tecophilaeaceae Leyb., *Bonplandia* 10: 370. Dec 1862, *nom. cons.* – T: *Tecophilaea* Bertero ex Colla (1836). – Tecophilaeaceae
- Theoideae** Reveal, subfam. nov., based on Theae Szyszyl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III. 6: 180, 181. Mai 1893. – T: *Thea* L. (1753).
- Thurnieae** Reveal, trib. nov., based on Thurniaceae Engl., *Syllabus*, ed. 5: 94. 20–22 Jul 1907, *nom. cons.* – T: *Thurnia* Hook.f. (1883). – Thurniaceae
- Trichopoideae** Reveal, subfam. nov., based on Trichopodaceae Hutch., *Fam. Fl. Pl.* 2: 143. 20 Jul 1934, *nom. cons.* – T: *Trichopus* Gaertn. (1788). – Dioscoreaceae
- Xanthorrhoeoidae** Reveal, subfam. nov., based on Xanthorrhoeae Benth., *Fl. Austral.* 7: 93, 112. 23–30 Mar 1878. – T: *Xanthorrhoea* Sm. (1798). – Hemerocallidaceae

The basic rule, that infrafamilial names of conserved families above the rank of genus have priority over earlier names based on non-conserved families names, essentially renders a series of names effectively conserved even though conservation in a strict sense is not authorized by the current code of nomenclature for algae, fungi, and plants (McNeill et al. 2006; McNeill & Turland 2011; McNeill & al. 2011) for names at these ranks. A distinct advantage of the approved proposal, however, is that the use of a single generic stem for all infrafamilial ranks for the majority of conserved family names is now mandated, a tradition long established in botanical nomenclature (e.g., Magnoliaceae, Magnolioideae, Magnoliaceae, Magnoliinae) even if there exists an earlier name. Nonetheless, the resulting nomenclature of any given family can be significantly altered when two or more conserved family names are included within a single family. For example, if Dialypetalanthaceae is excluded from Rubiaceae, a large and well-known subfamily of Rubiaceae must be termed Ixoroideae (1820), but if included, as now is the case (Reveal & Chase 2011), then the name of this taxon must be if Dialypetalanthoideae. Proper assignment of infrafamilial names to some of the large and complex families, such as Malvaceae, can only be done with a clear understanding of the phylogeny of the family so as to ascertain if some long-used, traditional name might have to be changed. One example of an unfortunate change mandated by this new rule is the required adoption of Ambrosiaceae over Heliantheae in Asteraceae. Finally, it is critical to take into account superconservation notes in App. IIB of the current *Code*, for only by consulting this document will one realize that Maloideae (1964) has priority over Amygdaloideae (1832).

Below is a listing of subfamily, supertribe, tribe, and subtribe names based on conserved family names. For a full list of conserved family names in App. IIB see McNeill et al. (2006).

- Abietaceae** Gray, *Nat. Arr. Brit. Pl.* 2: 222, 223. 10 Jan 1822, *nom. cons.*  
**Abietae** Dumort., *Fl. Belg.*: 9. 1827  
**Abietinae** Eichler in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* II, 1: 65, 69. Jun 1887  
**Abietioideae** Sweet, *Hort. Brit.*: 372. Sep–Oct 1826
- Acanthaceae** Juss., *Gen. Pl.*: 102. 4 Aug 1789, *nom. cons.*  
**Acantheae** Dumort., *Anal. Fam. Pl.*: 23. 1829  
**Acanthinae** Nees in N. Wallich, *Pl. Asiat. Rar.* 3: 76. 15 Aug 1832  
**Acanthoideae** Eaton, *Bot. Dict.*, ed. 4: 33. Apr–Mai 1836
- Aceraceae** Juss., *Gen. Pl.*: 250. 4 Aug 1789, *nom. cons.*  
**Acereae** Dumort., *Fl. Belg.*: 113. 1827

- Aceroideae Eaton, Bot. Dict., ed. 4: 39. Apr-Mai 1836  
 Achariaceae Harms in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. Nachtr.: 256. 4 Oct 1897, *nom. cons.*  
 Achariaceae Benth. & Hook.f., Gen. Pl. 1: 809. Sep 1867  
 Actinidiaceae Engl. & Gilg, Syllabus, ed. 9-10: 279. 6 Nov 1924, *nom. cons.*  
 Actinidiaceae Gilg in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 6: 110. Mar 1893  
 Actinidioideae Gilg in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 6: 110. Mar 1893  
 Adiantaceae Newman, Hist. Brit. Ferns: 5. 1-5 Feb 1840, *nom. cons.*  
 Adiantaceae Gaudich. in H.L.C. de Saules de Freycinet, Voy. Uranie, Bot.: 402. 18 Jul 1829  
 Adiantinae Pfeiff., Nomencl. Bot. 1(1): 46. ante 8 Dec 1871  
 Adiantioideae Horvát in Acta Bot. Inst. Bot. Univ. Zagreb. 2: 114. 1927  
 Adoxaceae E. Mey., Preuss. Pfl.-Gatt.: 198. 1-7 Sep 1839, *nom. cons.*  
 Adoxeae Dumort., Fl. Belg.: 84. 1827  
 Adoxoideae Syme in J.E. Smith & J. Soweby, Engl. Bot., ed. 3(B), 4: 197. 1865  
 Aextoxicaceae Engl. & Gilg in H.G.A. Engler, Syllabus, ed. 8: 250. Jan-Feb 1920, *nom. cons.*  
 Aextoxicaceae Baill., Hist. Pl. 2: 491, 493. 1870  
 Agavaceae Dumort., Anal. Fam. Pl.: 57, 58. 1829, *nom. cons.*  
 Agaveae Dumort., Anal. Fam. Pl.: 58. 1829  
 Agavoideae Herb., Amaryllidaceae: 48, 57, 67, 121. late Apr 1837  
 Aizoaceae Martinov, Tekhno-Bot. Slovar: 15. 3 Aug 1820, *nom. cons.*  
 Aizooae Rchb., Fl. Germ. Excurs. 2(2): 575, 586. 1832  
 Aizoinae K. Müll. in Bot. Jahrb. Syst. 42(Beibl. 97): 94. 29 Dec 1908  
 Aizooideae Spreng. ex Arn., Botany: 112. 9 Mar 1832  
 Alangiaceae DC. in D.F.L. von Schlechtendal, Linnaea 2: 505. Aug-Oct 1827, *nom. cons.*  
 Alangiae Horan., Char. Ess. Fam.: 137. 17 Jun 1847  
 Alangioideae Burnett, Outlines Bot.: 723, 1092, 1134. Feb 1835  
 Alismataceae Vent., Tabl. Règne Vég. 2: 157. 5 Mai 1799, *nom. cons.*  
 Alismataceae Dumort., Fl. Belg.: 135. 1827  
 Alismatinae Pichon in Notul. Syst. 12: 181. Feb 1946  
 Alismatoideae Arn., Botany: 136. 9 Mar 1832  
 Alliaceae Borkh., Bot. Wörterb. 1: 15. 1797, *nom. cons.*  
 Allieae Dumort., Fl. Belg.: 139. 1827  
 Alliinae Parl., Fl. Ital. 2: 510. 1852  
 Allioideae Herb., Amaryllidaceae: 48. late Apr 1837  
 Alsinaceae Bartl. in F.G. Bartling & H.L. Wendland, Beitr. Bot. 2: 159. Dec 1825, *nom. cons.*  
 Alsineae Lam. & DC., Syn. Pl. Fl. Gall.: 392. 30 Jun 1806  
 Alsinoideae Beilschm. in Flora 16(Beibl. 7): 92, 110. 14 Jun 1833  
 Alstroemeriaceae Dumort., Anal. Fam. Pl.: 57, 58. 1829, *nom. cons.*  
 Alstroemeriae Bernh. in Flora 23: 425. 21 Jul 1840  
 Alstroemerioideae Herb., Amaryllidaceae: 87. late Apr 1837  
 Altingiaceae Horan., Osnov. Bot.: 271. 1841, *nom. cons.*  
 Altingieae Rchb., Fl. Germ. Excurs. 1(2): 162. Jan-Apr 1831  
 Altingioideae J. Williams in J.H. Balfour, Man. Bot., ed. 3: 524. 1855  
 Amaranthaceae Juss., Gen. Pl.: 87. 4 Aug 1789, *nom. cons.*  
 Amaranthaceae Rchb., Fl. Germ. Excurs. 2(2): 575, 583. 1832  
 Amaranthinae Fenzl in S.F.L. Endlicher, Gen. Pl.: 303. Oct 1837  
 Amaranthoideae Burnett, Outlines Bot.: 591, 593, 1091, 1142. Feb 1835  
 Amaryllidaceae J. St.-Hil., Expos. Fam. Nat. 1: 134. Feb-Apr 1805, *nom. cons.*  
 Amaryllideae Dumort., Anal. Fam. Pl.: 58. 1829  
 Amaryllidinae Walp., Ann. Bot. Syst. 3: 616. 28-29 Sep 1852  
 Amaryllidoideae Burnett, Outlines Bot.: 446. Feb 1835

- Ambrosiaceae Bercht. & J. Presl, Pfl. Rostlin: 254. Jan-Apr 1820, *nom. cons.*  
 Ambrosiaceae Cass. in J. Phys. Chim. Hist. Nat. Arts 88: 191. Mar 1819  
 Ambrosiinae Less. in Linnaea 5: 151. Jan 1830  
 Ambrosioideae Raf. in Ann. Gén. Sci. Phys. Bruxelles 6: 88. Oct-Dec 1820  
 Amygdalaceae Marquis, Esq. Règne Vég.: 49. 15-22 Jul 1820, *nom. cons.*  
 Amygdaleae DC., Prodr. 2: 529. Nov (med.) 1825  
 Amygdaloideae Arn., Botany: 107. 9 Mar 1832  
 Anacardiaceae R. Br., Observ. Congo 12. 3 Mar 1818, *nom. cons.*  
 Anacardiaceae DC., Prodr. 2: 62. Nov (med.) 1825  
 Anacardiinae Meisn., Pl. Vasc. Gen.: Tab. Diagn. 75. 27 Aug-3 Sep 1837  
 Anacardioidae Arn., Botany: 106. 9 Mar 1832  
 Ancistrocladaceae Planch. ex Walp., Ann. Bot. Syst. 2: 175. 15-16 Dec 1851, *nom. cons.*  
 Ancistrocladeae Baill., Hist. Pl. 4: 210, 218. 1872  
 Annonaceae Juss., Gen. Pl.: 283. 4 Aug 1789, *nom. cons.*  
 Annoneae Endl., Gen. Pl.: 833. Jun 1839  
 Annoninae Engl. & Diels in H.G.A. Engler, Monogr. Afr. Pflanzen-Fam. 6: 7. Nov 1901  
 Annonoideae Raf., Anal. Nat.: 175. Apr-Jul 1815  
 Apiaceae Lindl., Nat. Syst. Bot., ed. 2: 21. 13 Jun 1836, *nom. cons.*  
 Apiae Takht. ex V.M. Vinogr., Fl. Vostochnoi Evropy 11: 339. 2004  
 Apiinae Caruel in F. Parlatore, Fl. Ital. 8: 389. Mar 1889  
 Apioideae Seem., Fl. Vit.: 112. Jan 1866  
 Apocynaceae Juss., Gen. Pl.: 143. 4 Aug 1789, *nom. cons.*  
 Apocynae Rehb., Fl. Germ. Excurs. 1(3): 410, 429. Jul-Dec 1831  
 Apocyninae Pichon ex Lecuw. in Wageningen Agric. Univ. Pap. 94(3): 59. 19 Aug. 1994  
 Apocynoideae Burnett, Outlines Bot.: 1012, 1095, 1104. Feb 1835  
 Aponogetonaceae Planch. in Bot. Mag. 82: ad. t. 4894. 1 Jan 1856, *nom. cons.*  
 Aponogtoneae Benth. & Hook.f., Gen. Pl. 3: 1011. 14 Apr 1883  
 Apostasiaceae Lindl., Nix. Pl.: 22. 17 Sep 1833, *nom. cons.*  
 Apostasiae R. Br. ex Spach, Hist. Nat. Vég. 12: 182. 27 Jun 1846  
 Apostasioideae Horan., Char. Ess. Fam.: 46. 17 Jun 1847  
 Aquifoliaceae Bercht. & J. Presl, Pfl. Rostlin: 2(110): 438, 440. 1825, *nom. cons.*  
 Aquifolieae DC., Prodr. 2: 3. Nov (med.) 1825  
 Aquifolioideae Burnett, Outlines Bot.: 618, 1092, 1140. Feb 1835  
 Araceae Juss., Gen. Pl.: 23. 4 Aug 1789, *nom. cons.*  
 Araceae R. Br. ex Duby, Bot. Gall. 1: 480. 12-14 Apr 1828  
 Arinae Schott, Prodr. Syst. Aroid.: 73. 1 Mai-15 Aug 1860  
 Aroideae Arn., Botany: 136. 9 Mar 1832  
 Araucariaceae Henkel & W. Hochst., Syn. Nadelhölz.: xvii, 1. 17-18 Jan 1865, *nom. cons.*  
 Araucariaceae D. Don in Trans. Linn. Soc. London 18: 163. 1839  
 Araucariinae Parl. in A.P. de Candolle and A.L.P.P. de Candolle, Prodr. 16(2): 363, 369. Jul (med.) 1868  
 Araucarioideae Beilschm. in Flora 16(Beibl. 7): 58, 104. 14 Jun 1833  
 Arecaceae Bercht. & J. Presl, Pfl. Rostlin: 266. Jan-Apr 1820, *nom. cons.*  
 Arecaceae Dumort., Anal. Fam. Pl.: 56. 1829  
 Arecinae Engl. in Bot. Jahresber. (Just) 3: 456. Mai-Dec 1877  
 Arecoidae Burnett, Outlines Bot.: 401. Feb 1835  
 Aristolochiaceae Juss., Gen. Pl.: 72. 4 Aug 1789, *nom. cons.*  
 Aristolochiaceae Dumort. ex Spach, Hist. Nat. Vég. 10: 560. 20 Mar 1841  
 Aristolochioideae Burnett, Outlines Bot.: 584, 1091, 1143. Feb 1835  
 Asclepiadaceae Borkh., Bot. Wörterb. 1: 31. 1797, *nom. cons.*  
 Asclepiadeae Duby, Bot. Gall. 1: 323. 12-14 Apr 1828



- Asclepiadinae Decne. ex Miq., Fl. Ned. Ind. 2: 484. 20 Aug 1857  
 Asclepiadoideae Burnett, Outlines Bot.: 1012, 1095, 1103. Feb 1835  
 Asparagaceae Juss., Gen. Pl.: 40. 4 Aug 1789, *nom. cons.*  
 Asparageae Dumort., Fl. Belg.: 138. 1827  
 Asparagoideae Burmeist., Handb. Naturgesch.: 224. 1837  
 Asteraceae Bercht. & J. Presl, Pfl. Rostlin: 254. Jan-Apr 1820, *nom. cons.*  
 Astereae Cass. in J. Phys. Chim. Hist. Nat. Arts 88: 195. Mar 1819  
 Asterinae Dumort., Fl. Belg.: 66. 1827  
 Asteroideae Lindl. in J.C. Loudon, Encycl. Pl.: 1074. 1829  
 Asteranthaceae R. Knuth in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenr. IV, 219b (Heft 105): 1. 22 Aug 1939, *nom. cons.*  
 Asteranthaeae Pichon in Notul. Syst. 12: 196. Feb 1946  
 Asteranthoideae Reveal in Phytoneuron 2012-33: 1. 9 Apr 2012  
 Austrobaileyaceae Croizat in Cact. Succ. J. (Los Angeles) 15: 64. Mai 1943, *nom. cons.*  
 Austrobaileyoideae Croizat in J. Arnold Arbor. 21: 404. 24 Jul 1940  
 Avicenniaceae Miq. in J.G.C. Lehmann, Pl. Preiss. 1: 353. 14-16 Aug 1845, *nom. cons.*  
 Avicenniaceae Benth. in Ann. Mag. Nat. Hist., ser. 1, 2: 450. Feb 1839  
 Avicennioideae Miers in London J. Bot. 7: 58. 1848  
  
 Balanitaceae M. Roem., Fam. Nat. Syn. Monogr. 1: 26. 14 Sep-15 Oct 1846, *nom. cons.*  
 Balaniteae Dumort., Anal. Fam. Pl.: 45. 1829  
 Balanitoideae Engl. in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 4: 354, 355. Jul 1896  
 Balanopaceae Benth. & Hook.f., Gen. Pl. 3: v, 341. 7 Feb 1880, *nom. cons.*  
 Balanopaeae Baill., Hist. Pl. 6: 245, 258. Jan-Mai 1876  
 Balanophoraceae Rich. in Mém. Mus. Hist. Nat. 8: 429. 18 Nov 1822, *nom. cons.*  
 Balanophoreae Engl. in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 1: 250, 260. Aug 1889  
 Balanophoroideae Engl. in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. III, 1: 250, 260. Aug 1889  
 Balsaminaceae A. Rich. in J.B.G.M. Bory de Saint-Vincent, Dict. Class. Hist. Nat. 2: 173. 31 Dec 1822, *nom. cons.*  
 Balsamineae Dumort., Anal. Fam. Pl.: 46. 1829  
 Balsaminoideae Arn., Botany: 103. 9 Mar 1832  
 Barbeyaceae Rendle in D. Oliver (ed. D. Prain), Fl. Trop. Afr. 6(2): 14. Mar 1916, *nom. cons.*  
 Barbeyaeae Kuntze in T.E. von Post & C.E.O. Kuntze, Lex. Gen. Phan.: 633. 20-30 Nov 1903.  
 Barbeyoideae Engl. in H.G.A. Engler & K.A.E. Prantl, Nat. Pflanzenfam. Nachtr.: 119. 2 Aug 1897  
 Barringtoniaceae DC. ex F. Rudolphi, Syst. Orb. Veg.: 56. 5-12 Jul 1830, *nom. cons.*  
 Barringtoniae DC. in D.F.L. von Schlechtendal, Linnæa 2: 505. Jul 1827  
 Barringtoniinae Benth. & Hook.f., Gen. Pl. 1: 695. 19 Oct 1865  
 Barringtonioideae Beilschm. in Flora 16(Beibl. 7): 98, 104. 14 Jun 1833  
 Basellaceae Raf., Fl. Tellur. 3: 44. Nov-Dec 1837, *nom. cons.*  
 Baselleae Fenzl in S.F.L. Endlicher, Gen. Pl.: 297. Oct 1837  
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## ATLAS OF THE FLORA OF NEW ENGLAND: ASTERACEAE

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### ABSTRACT

Dot maps are provided to depict the distribution at the county level of the taxa of Magnoliophyta: Asteraceae (corresponding to Flora of North America, Vols. 19, 20, 21) growing outside of cultivation in the six New England states of the northeastern United States. The maps treat 491 taxa (species, subspecies, varieties, and hybrids, but not forms) based primarily on specimens in the major herbaria of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, with most data derived from the holdings of the New England Botanical Club Herbarium (NEBC). Brief synonymy (to account for names used in standard manuals and floras for the area), habitat, chromosome information, and common names are also provided.

**KEY WORDS:** flora, New England, atlas, distribution, Asteraceae

This article is the ninth in a series (Angelo & Boufford 1996, 1998, 2000, 2007, 2010, 2011a, 2011b, 2012) that present the distributions of the vascular flora of New England in the form of dot distribution maps at the county level (Figure 1). The atlas is posted on the internet at <http://neatlas.org>, where it will be updated as new information becomes available.

This project encompasses all vascular plants (lycophytes, pteridophytes and spermatophytes) at the rank of species, subspecies, and variety growing independent of cultivation in the six New England states. Hybrids are also included, but forms and other ranks below the level of variety are not. The dots are based on voucher specimens primarily in New England herbaria (of colleges, universities, botanical gardens, and public museums) representing reproducing populations outside of cultivated habitats. This ninth installment includes the family in Magnoliophyta: Asteraceae corresponding to the family treated in Flora of North America, Vols. 19, 20, 21 (Flora of North America Editorial Committee 2006a, 2006b, 2006c). Of the 491 taxa treated, 223 are not native to the region. Future accounts will treat the distribution of additional non-monocot angiosperms.

The habitat data are distillations from a variety of sources augmented by our own field observations. An attempt was made to indicate habitat information as it applies to a particular taxon in New England rather than to the entire range of the taxon. Such information is omitted where habitat is not indicated on the specimen label and where we also lack personal knowledge of the plant in New England. Omissions of habitat information are for a few introduced taxa and for all hybrids.

It is our hope that these articles will stimulate additional field work to supplement the distributions portrayed in the maps. The New England Botanical Club herbarium has proven to be the most important resource for this project. We are eager to receive information on voucher specimens in public herbaria documenting range extensions and filling county gaps in distributions. Similarly, because the atlas of the New England flora will be continuously updated as new information becomes available, we are eager to receive notification of published corrections of cytological information and new, documented chromosome counts for taxa in the New England flora.

## MATERIALS AND METHODS

Materials and methods are as outlined in Angelo and Boufford (1996) and in a web version (Angelo & Boufford 2011c) and are not repeated here.

## TAXONOMY AND FORMAT

The taxonomy and nomenclature adopted for this work essentially follow that of the Flora of North America project, except that families, genera, and species are arranged alphabetically. The families and their circumscription do not necessarily reflect current views on relationships or composition. The Angiosperm Phylogeny Website (Stevens 2001 onwards) should be consulted for a continuously updated treatment of families and their inclusive genera. Named and unnamed hybrid taxa are placed alphabetically at the end of the genus in which they occur. Unnamed hybrids combine the names of the progenitors alphabetically by epithet. Taxa that are not native to New England are indicated by uppercase text. Unpublished names are not used, even if publication is pending.

Chromosome numbers are taken primarily from Flora of North America, Vols. 19, 20, 21 (Flora of North America Editorial Committee 2006a, 2006b, 2006c) and from Goldblatt and Johnson (1979–).

Synonymy is provided primarily with respect to names accepted in standard manuals covering New England published from 1950 onward, including Fernald (1950), Gleason (1952), Gleason and Cronquist (1991), and Seymour (1982). Synonyms have not been provided where the distribution for the synonymized name does not include New England.

The following list (which includes excluded taxa) will aid readers in finding familiar names that have been transferred to other taxa:

<i>Actinomeris</i>	=>	<i>Verbestina</i>
<i>Anthemis</i> (in part)	=>	<i>Chamaemelum</i>
<i>Anthemis</i> (in part)	=>	<i>Cota</i>
<i>Aster</i> (in part)	=>	<i>Doellingeria</i>
<i>Aster</i> (in part)	=>	<i>Eurybia</i>
<i>Aster</i> (in part)	=>	<i>Ionactis</i>
<i>Aster</i> (in part)	=>	<i>Oclemena</i>
<i>Aster</i> (in part)	=>	<i>Sericocarpus</i>
<i>Aster</i> (in part)	=>	<i>Solidago</i>
<i>Aster</i> (in part)	=>	<i>Symphytotrichum</i>
<i>Baeria</i> (in part)	=>	<i>Lasthenia</i>
<i>Cacalia</i>	=>	<i>Hasteola</i>
<i>Chrysanthemum</i> (in part)	=>	<i>Glebionis</i>
<i>Chrysanthemum</i> (in part)	=>	<i>Leucanthemella</i>
<i>Chrysanthemum</i> (in part)	=>	<i>Leucanthemum</i>
<i>Chrysanthemum</i> (in part)	=>	<i>Nipponanthemum</i>
<i>Chrysanthemum</i> (in part)	=>	<i>Tanacetum</i>
<i>Chrysopsis</i> (in part)	=>	<i>Pityopsis</i>
<i>Cnicus</i>	=>	<i>Centaurea</i>
<i>Dyssodia</i> (in part)	=>	<i>Thymophylla</i>
<i>Erigeron</i> (in part)	=>	<i>Conyza</i>
<i>Eupatorium</i> (in part)	=>	<i>Ageratina</i>
<i>Eupatorium</i> (in part)	=>	<i>Eutrochium</i>
<i>Gnaphalium</i> (in part)	=>	<i>Euchiton</i>
<i>Gnaphalium</i> (in part)	=>	<i>Gamochaeta</i>
<i>Gnaphalium</i> (in part)	=>	<i>Omalotheca</i>

<i>Gnaphalium</i> (in part)	=>	<i>Pseudognaphalium</i>
<i>Haplopappus</i> (in part)	=>	<i>Xanthisma</i>
<i>Helichrysum</i> (in part)	=>	<i>Xerachrysum</i>
<i>Hemizonia</i> (in part)	=>	<i>Deinandra</i>
<i>Imula</i> (in part)	=>	<i>Dittrichia</i>
<i>Iva</i> (in part)	=>	<i>Cyclachaena</i>
<i>Lactuca</i> (in part)	=>	<i>Mulgednum</i>
<i>Lactuca</i> (in part)	=>	<i>Mycelis</i>
<i>Matricaria</i> (in part)	=>	<i>Tripleurospermum</i>
<i>Megalodonta</i>	=>	<i>Bidens</i>
<i>Picris</i> (in part)	=>	<i>Helminthotheca</i>
<i>Senecio</i> (in part)	=>	<i>Packera</i>
<i>Solidago</i> (in part)	=>	<i>Euthamia</i>

The following species have been reported from our area but are excluded for the reasons noted:

*ACANTHOSPERMUM AUSTRALE* (Loeffling) Kuntze [no voucher found for wild occurrence; reported from Massachusetts]

*AMBERBOA MOSCHATA* (Linnaeus) de Candolle [no voucher found for wild occurrence; reported from Maine]

*Antennaria rosea* Greene subsp. *pulvinata* (Greene) R.J. Bayer [no specimen located; reported from Maine]

*ARCTANTHEMUM ARCTICUM* (Linnaeus) Tzvelev subsp. *POLARE* (Hult  n) Tzvelev [no specimen located; reported from Massachusetts]

*ARTEMISIA DRACUNCULUS* Linnaeus (*A. GLAUCA* Pallas ex Willdenow var. *DRACUNCULINA* (S. Watson) Fernald) [no specimen located; reported from Massachusetts]

*BRICKELLIA GRANDIFLORA* (Hooker) Nuttall [no specimen located; reported from Rhode Island]

*CARTHAMUS LANATUS* Linnaeus [no voucher found for wild occurrence; reported from Massachusetts]

*CENTAUREA BOVINA* Velenovsk  y [no specimen located; reported from Massachusetts]

*CENTAUREA PHRYGIA* Linnaeus (*C. AUSTRIACA* Willdenow) [no specimen located; reported from Vermont]

*CENTIPEDA MINIMA* (Linnaeus) A. Braun & Ascherson [no voucher found for wild occurrence; reported from Massachusetts]

*COTULA AUSTRALIS* (Sieber ex Sprengel) Hooker f. [no specimen located; reported from Maine]

*CHRYSANTHEMUM*  $\times$  *MORIFOLIUM* (Ramatuelle) Hemsley (*pro species*) – (*C. INDICUM* Linnaeus  $\times$  *C. JAPONICUM* Thunberg) [no specimen located; reported from Massachusetts]

- CHRYSOGONUM VIRGINIANUM* Linnaeus var. *BREVISTOLON* G.L. Nesom [no specimen located; reported from Rhode Island]
- CIRSIMUM CANUM* (Linnaeus) Allioni [no specimen located; reported from Massachusetts]
- CREPIS PANNONICA* (Jacquin) K. Koch [no specimen located; reported from Connecticut]
- CRUPINA VULGARIS* Persoon ex Cassini [no specimen located; reported from Massachusetts]
- EUCHITON INVOLUCRATUS* (G. Forster) Anderberg (*GNAPHALIUM INVOLUCRATUM* G. Forster) [no voucher found for wild occurrence; reported from Massachusetts]
- EUPATORIUM CAPILLIFOLIUM* (Lamarck) Small [no specimen located; reported from Connecticut and Massachusetts]
- Eurybia chlorolepis* (E.S. Burgess) G.L. Nesom [specimen from Connecticut at CONN identified as this taxon is judged to be misidentified]
- EURYBIA SURCULOSA* (Michaux) G.L. Nesom (*ASTER SURCULOSA* Michaux) [no specimen located; reported from Massachusetts and Connecticut]
- FLAVERIA TRINERVIA* (Sprengel) C. Mohr [no voucher found for wild occurrence; reported from Massachusetts]
- GAILLARDIA ARISTATA* Pursh [no voucher found for wild occurrence; reported from Connecticut, Massachusetts and New Hampshire]
- HELLANTHUS DEBILIS* Nuttall subsp. *DEBILIS* [no voucher found for wild occurrence; reported from Maine]
- HELLANTHUS HIRSUTUS* Rafinesque [no specimen located; reported from Connecticut]
- HELLANTHUS MICROCEPHALUS* Torrey & A. Gray [no voucher found for wild occurrence; reported from Connecticut]
- HELLANTHUS OCCIDENTALIS* Riddell subsp. *OCCIDENTALIS* Torrey & A. Gray [no specimen located; reported from Massachusetts]
- INULA SALICINA* Linnaeus [no specimen located; reported from Massachusetts]
- Lactuca floridana* (Linnaeus) Gaertner [voucher has been re-identified as *L. biennis*; reported from Massachusetts]
- LACTUCA SALIGNA* Linnaeus [no specimen located; reported from Maine and Massachusetts]
- LIATRIS LIGULISTYLIS* (A. Nelson) K. Schumann [no specimen located; reported from Connecticut]

- LIATRIS SCARIOSA* (Linnaeus) Willdenow var. *NIEUWLANDII* (Lunell) E. G. Voss (*L. × NIEUWLANDII* (Lunell) Gaiser) [no specimen located; reported from Connecticut and Rhode Island]
- LOGFIA MINIMA* (Smith) Dumortier (*FILAGO MINIMA* (Smith) Persoon) [no voucher found for wild occurrence; reported from Massachusetts]
- PEREZIA MULTIFLORA* (Bonpland) Lessing subsp. *SONCHIFOLIA* (Baker) Vuilleumier (*P. ALETES* J. F. Macbride) [no voucher found for wild occurrence; reported from Massachusetts]
- PETASITES JAPONICUS* (Siebold & Zuccarini) Maximowicz [no voucher found for wild occurrence; reported from Maine]
- Rudbeckia laciniata* Linnaeus var. *bipinnata* Perdue [no specimen located; reported from Connecticut, Massachusetts and New Hampshire]
- SANVITALIA PROCUMBENS* Lamarck [no voucher found for wild occurrence; reported from Vermont]
- SCHKUHRIA PINNATA* (Lamarck) Kuntze ex Thellung [no voucher found for wild occurrence; reported from Maine and Massachusetts]
- Senecio pseudoarnica* Lessing [no specimen located; reported from Maine]
- SENECIO SPARTIOIDES* Torrey & A. Gray (*S. MULTICAPITATUS* Greenman) [no specimen located; reported from Massachusetts]
- SERRATULA TINCTORIA* Linnaeus [no specimen located; reported from Connecticut]
- SIGESBECKIA ORIENTALIS* Linnaeus [no specimen located; reported from Middlesex Co., Massachusetts, almost certainly based on the voucher for *S. JORULLENSIS* Kunth from the same county]
- Solidago erecta* Banks ex Pursh [no specimen located; specimen from Plymouth Co., Massachusetts at CONN identified as this taxon is judged to be misidentified; reported from Connecticut, Massachusetts and Rhode Island]
- SOLIDAGO LEPIDA* de Candolle var. *SALEBROSA* (Piper) Semple (*S. CANADENSIS* Linnaeus var. *SALEBROSA* (Piper) M. E. Jones) [no specimen located; reported from Maine]
- Solidago × beaudryi* B. Boivin (*S. rugosa* Miller var. *rugosa* × *S. uliginosa* Nuttall) [no specimen located; reported from Maine]
- Symphytotrichum × gravesii* (E.S. Burgess) G.L. Nesom (*pro species*) -- (*S. dumosum* (Linnaeus) G. L. Nesom × *S. laeve* (Linnaeus) Å. Löve & D. Löve var. *laeve*; *Aster gravesii* E. S. Burgess) [no specimen located; reported from Connecticut]
- SYMPHYOTRICHUM LANCEOLATUM* (Willdenow) G.L. Nesom var. *HIRSUTICAULE* (Semple & Chmielewski) G.L. Nesom (*ASTER LANCEOLATUS* Willdenow var.



*HIRSUTICAULIS* Semple & Chmielewski) [no specimen located; reported from Massachusetts, apparently from incorrect reading of a checklist]

*Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *crenifolium* (Fernald) Labrecque & Brouillet (*Aster crenifolius* (Fernald) Cronquist) [no specimen located; reported from Maine, New Hampshire and Vermont]

*Symphyotrichum phlogifolium* (Muhlenberg ex Willdenow) G.L. Nesom (*Aster patens* Aiton var. *phlogifolius* (Muhlenberg ex Willdenow) Nees) [no specimen located; reported from Connecticut, Massachusetts, and Rhode Island]

*Taraxacum ceratophorum* (Ledebour) de Candolle [no specimen located; reported from Massachusetts and New Hampshire]

*VERNONIA GLAUCA* (Linnaeus) Willdenow [no specimen located; reported from Massachusetts]

## ANGIOSPERMAE (MAGNOLIOPHYTA) - ANGIOSPERMS

### ASTERACEAE

*ACHILLEA FILIPENDULINA* Lamarck—Gold Yarrow (Figure 2).  $2n = 18, 36, 54$ . Clay soil. From the Caucasus and western Asia.

*ACHILLEA LIGUSTICA* Allioni—Ligurian Yarrow (Figure 2).  $2n = 18$ . Roadsides. From the Mediterranean.

*Achillea millefolium* Linnaeus—Common Yarrow (Figure 2).  $2n = 18, 27, 36, 45, 63, 72$  (including counts from Europe). Dry fields, roadsides, waste grounds. [*A. borealis* Bongard; *A. lamulosa* Nuttall]

*ACHILLEA PTARMICA* Linnaeus—Sneezewort (Figure 2).  $2n = 18$ . Roadsides, fields. From Eurasia.

*Ageratina altissima* (Linnaeus) R.M. King & H. Robinson var. *altissima*—White Snakeroot (Figure 2).  $2n = 34$ . Rich, moist woods, especially along rivers. [*Eupatorium rugosum* Houttuyn]

*Ageratina aromatica* (Linnaeus) Spach—Smaller White Snakeroot (Figure 2).  $2n = 34$ . Dry, open woods, clearings, thickets. [*Eupatorium aromaticum* Linnaeus]

*AGERATUM CONYZOIDES* Linnaeus—Billygoat-weed (Figure 2).  $2n = 20, 40$ . Waste ground. From South America.

*AGERATUM HOUSTONIANUM* Miller—Bluemink (Figure 2).  $2n = 20$ . Disturbed sites. From southeastern Mexico and Central America

*Ambrosia artemisiifolia* Linnaeus—Common Ragweed (Figure 2).  $2n = 34, 36$ . Waste areas, roadsides, fields. [*A. artemisiifolia* var. *elatior* (Linnaeus) Descourtiz; *A. artemisiifolia* var. *paniculata* (Michaux) Blankinship]

*Ambrosia bidentata* Michaux—Southern Ragweed (Figure 3).  $2n = 34$ . Waste ground.

*AMBROSIA PSILOSTACHYA* de Candolle—Western Ragweed (Figure 3).  $2n = 18, 27, 36, 45, 54, 63, 72, 100-104, 108, 144$ . Railroads, waste places, dry fields. From farther west. [*A. PSILOSTACHYA* var. *CORONOPIFOLIA* (Torrey & A. Gray) Farwell]

*Ambrosia trifida* Linnaeus—Great Ragweed (Figure 3).  $2n = 24, 48$ . Waste places, railroads, rich, damp soil. [*A. trifida* var. *texana* Scheele]

— *Ambrosia* hybrid—

*Ambrosia* × *helenae* Rouleau—(Figure 3). [*A. artemistifolia* Linnaeus × *A. trifida* Linnaeus]

*Anaphalis margaritacea* (Linnaeus) Benth. & Hook. f.—Pearly Everlasting (Figure 3).  $2n = 28$ . Dry woods, clearings, fields, roadsides. [*A. margaritacea* var. *angustior* (Miquel) Nakai; *A. margaritacea* var. *intercedens* H. Hara; *A. margaritacea* var. *subalpina* (A. Gray) A. Gray]

*Antennaria howellii* Greene subsp. *canadensis* (Greene) R.J. Bayer—(Figure 3).  $2n = 56, 84$ . Dry fields, open woods. [*A. canadensis* Greene]

*Antennaria howellii* Greene subsp. *neodioica* (Greene) R.J. Bayer—Smaller Pussytoes (Figure 3).  $2n = 56, 84$ . Dry fields, open woods. [*A. neglecta* Greene var. *neodioica* (Greene) Cronquist; *A. neodioica* Greene var. *neodioica*; *A. neodioica* var. *attenuata* Fernald; *A. neodioica* var. *chlorophylla* Fernald; *A. neodioica* var. *grandis* Fernald; *A. rupicola* Fernald]

*Antennaria howellii* Greene subsp. *petaloidea* (Fernald) R.J. Bayer—(Figure 3).  $2n = 56, 84$ . Dry fields, open woods. [*A. neglecta* Greene var. *neodioica* (Fernald) Cronquist; *A. petaloidea* (Fernald) Fernald var. *petaloidea*; *A. petaloidea* var. *scariosa* Fernald; *A. petaloidea* var. *subcorymbosa* (Fernald) Fernald]

*Antennaria neglecta* Greene—Field Pussytoes (Figure 3).  $2n = 28$ . Dry fields, open woods.

*Antennaria parlinii* Fernald subsp. *parlinii*—Smooth Pussytoes (Figure 4).  $2n = 56, 70, 84, 112$ . Dry fields, open woods. [*A. parlinii* var. *arnoglossa* (Greene) Fernald; *A. plantaginifolia* (Linnaeus) Richardson var. *arnoglossa* (Greene) Cronquist]

*Antennaria parlinii* Fernald subsp. *fallax* (Greene) R.J. Bayer & Stebbins—(Figure 4).  $2n = 56, 70, 84, 112$ . Dry fields, old woods. [*A. brainerdii* Fernald; *A. fallax* Greene; *A. munda* Fernald; *A. plantaginifolia* (Linnaeus) Richardson var. *ambigens* (Greene) Cronquist]

*Antennaria plantaginifolia* (Linnaeus) Hook.—(Figure 4).  $2n = 28$ . Dry, open woods, fields, rocky banks. [*A. plantaginifolia* var. *petiolata* (Fernald) A. Heller]

— *Antennaria* hybrid—

*Antennaria howellii* Greene subsp. *petaloidea* (Fernald) R.J. Bayer × *A. plantaginifolia* (Linnaeus) Hook.—(Figure 4).

*ANTHEMIS ARVENSIS* Linnaeus—Corn Chamomile (Figure 4).  $2n = 18$ . Waste places, fields, roadsides. From Eurasia, northern Africa. [*A. ARVENSIS* var. *AGRESTIS* (Wallroth) de Candolle]

*ANTHEMIS COTULA* Linnaeus—Mayweed (Figure 4).  $2n = 18$ . Waste places, fields, roadsides. From Eurasia, northern Africa.

*ARCTIUM LAPPA* Linnaeus—Great Burdock (Figure 4).  $2n = 32$  (Japan), 34 (China), 36 (Japan, Sweden). Waste places, roadsides. From Eurasia.

*ARCTIUM MINUS* (Hill) Bernhardt—Common Burdock (Figure 4).  $2n = 32$  (Germany), 36. Waste places, roadsides. From Eurasia. [*A. NEMOROSUM* – misapplied; *A. VULGARE* – misapplied]

*ARCTIUM TOMENTOSUM* Miller—(Figure 4).  $2n = 36$ . Waste places. From Eurasia.

—*Arctium* hybrid—

*ARCTIUM LAPPA* Linnaeus × *A. TOMENTOSUM* Miller—(Figure 5).

*ARCTOTIS STOECHADIFOLIA* P.J. Bergius—Blue-eyed African-daisy (Figure 5).  $2n = 18$ . Railroads. From southern Africa. [*A. VENUSTA* Norlindh]

*Arnica lanceolata* Nuttall subsp. *lanceolata*—(Figure 5).  $2n = 76$ . Damp banks and ledges in mountains, often subalpine. [*A. mollis* Hooker – misapplied; *A. mollis* var. *petiolaris* Fernald]

*ARNOSERIS MINIMA* (Linnaeus) Schweigger & Körte—Lamb's Succory (Figure 5).  $2n = 18$ . Fields. From Europe.

*ARTEMISIA ABROTANUM* Linnaeus—Southernwood (Figure 5).  $2n = 18$ . Waste places, roadsides. From Eurasia.

*ARTEMISIA ABSINTHIUM* Linnaeus—Common Wormwood (Figure 5).  $2n = 18$ . Dry fields, roadsides, waste places. From Eurasia, northern Africa.

*ARTEMISIA ANNUA* Linnaeus—Sweet Annie (Figure 5).  $2n = 18$ . Waste places, roadsides, fields. From Eurasia.

*ARTEMISIA BIENNIS* Willdenow—(Figure 5).  $2n = 18$ . Waste places, roadsides, clearings. From farther west.

*Artemisia campestris* Linnaeus subsp. *canadensis* (Michaux) Scoggan—Canada Wormwood (Figure 5).  $2n = ?$  Calcareous rocks and cliffs. [*A. canadensis* Michaux]

*Artemisia campestris* Linnaeus subsp. *caudata* (Michaux) H.M. Hall & Clements—(Figure 6).  $2n = ?$  Open, usually sandy, soil. [*A. caudata* Michaux]

*ARTEMISIA CARRUTHII* Alph. Wood ex Carruthers—(Figure 6).  $2n = 18$ . Railroads. From farther west.

*ARTEMISIA FILIFOLIA* Torrey—Sand Sage (Figure 6).  $2n = 18$ . Waste places. From farther west.

*ARTEMISIA FRIGIDA* Willdenow—Prairie Sagewort (Figure 6).  $2n = 18$ . Waste places, roadsides, railroads, dry fields. From farther west.

*ARTEMISIA LUDOVICIANA* Nuttall subsp. *LUDOVICIANA* R—Man Sage (Figure 6).  $2n = 18, 36$ . Roadsides, railroads, waste places. From farther west. [*A. LUDOVICIANA* var. *AMERICANA* (Besser) Fernald; *A. LUDOVICIANA* var. *BRITTONII* (Rydberg) Fernald; *A.*

*LUDOVICIANA* var. *GNAPHALOIDES* (Nuttall) Torrey & A. Gray; *A. LUDOVICIANA* var. *LATIFOLIA* (Besser) Torrey & A. Gray; *A. LUDOVICIANA* var. *PABULARIS* (A. Nelson) Fernald; *A. GNAPHALOIDES* Nuttall]

*ARTEMISIA PONTICA* Linnaeus—Roman Wormwood (Figure 6).  $2n = 18$ . Roadsides, railroads, waste places, fields. From Eurasia.

*ARTEMISIA STELLERIANA* Besser—Dusty Miller (Figure 6).  $2n = 18$ . Sandy beaches, dunes. From northeastern Asia, Alaskan islands.

*ARTEMISIA TRIDENTATA* Nuttall subsp. *TRIDENTATA*—Big Sagebrush (Figure 6).  $2n = 18, 36$ . Fields. From farther west.

*ARTEMISIA VULGARIS* Linnaeus—Common Mugwort (Figure 6).  $2n = 18, 36, 40, 54$ . Roadsides, railroads, waste places, thickets. Eurasia, northern Africa. [*A. VULGARIS* var. *GLABRA* Ledebour; *A. VULGARIS* var. *LATILOBA* Ledebour]

*ASTER TATARICUS* Linnaeus f.—Shion (Figure 7).  $2n = 54$ . Roadsides, waste places. From northern Asia.

*Baccharis halimifolia* Linnaeus—Sea-myrtle (Figure 7).  $2n = 18$ . Salt marshes, waste places.

*BELLIS PERENNIS* Linnaeus—English Daisy (Figure 7).  $2n = 18$ . Waste places, roadsides. From Eurasia, northern Africa.

*BIDENS ARISTOSA* (Michaux) Britton—Midwestern Tickseed-sunflower (Figure 7).  $2n = ?$ . Waste places, fields. From farther west. [*B. ARISTOSA* var. *FRITCHEYI* Fernald; *B. ARISTOSA* var. *MUTICA* (A. Gray) Gattinger ex Fernald]

*Bidens beckii* Torrey ex Sprengel—Water-marigold (Figure 7).  $2n = 26$ . Ponds, slow streams. [*Megalodonta beckii* (Torrey ex Sprengel) Greene]

*Bidens bipinnata* Linnaeus—Spanish-needles (Figure 7).  $2n = 24, 72$ . Waste places, roadsides.

*Bidens cernua* Linnaeus—Nodding Bur-marigold (Figure 7).  $2n = 24, 48$ . Swamps, shores, wet ditches, bottomlands, marshes. [*B. cernua* var. *elliptica* Wiegand; *B. cernua* var. *integra* Wiegand; *B. cernua* var. *minima* (Hudson) Pursh; *B. cernua* var. *oligodonta* Fernald & H. St. John]

*Bidens connata* Muhlenberg ex Willdenow—Swamp Beggar-ticks (Figure 7).  $2n = 48$ . Shores, swamps. [*B. connata* var. *fallax* (Warnstorf) Sherff; *B. connata* var. *gracilipes* Fernald; *B. connata* var. *petiolata* (Nuttall) Farwell]

*Bidens discordea* (Torrey & A. Gray) Britton—Small Beggar-ticks (Figure 7).  $2n = 24$ . Shores, swamps, marshes.

*Bidens eatonii* Fernald—(Figure 8).  $2n = 48$ . Tidal shores, estuaries and marshes. [*B. eatonii* var. *fallax* Fernald; *B. eatonii* var. *interstes* (Fassett) Fassett; *B. eatonii* var. *kennebecensis* Fernald; *B. eatonii* var. *major* Fassett; *B. eatonii* var. *mutabilis* Fassett; *B. eatonii* var. *simulans* Fassett]

*Bidens frondosa* Linnaeus—Common Beggar-ticks (Figure 8).  $2n = 24, 48, 72$ . Swamps, shores, damp, open places.

*Bidens heterodoxa* (Fernald) Fernald & H. St. John—(Figure 8).  $2n = 48$ . Lake shores. [*B. heterodoxa* var. *agnostica* Fernald; *B. heterodoxa* var. *monardifolia* Fernald]

*Bidens hyperborea* Greene—Estuary Beggar-ticks (Figure 8).  $2n = 24, 36$ . Tidal mud-flats. [*B. hyperborea* var. *cathancensis* Fernald; *B. hyperborea* var. *colpophila* (Fernald & H. St. John) Fernald]

*Bidens laevis* (Linnaeus) Britton, Sterns & Poggenberg—Larger Bur-marigold (Figure 8).  $2n = 22, 24$ . Marshes, shores of ponds and slow streams.

*BIDENS PILOSA* Linnaeus—Cobblers'-pegs (Figure 8).  $2n = 24, 36, 48, 72$ . Waste places. From Mexico, Central & South America. [*B. PILOSA* var. *RADIATA* (Schultz-Bipontinus) Schultz-Bipontinus]

*BIDENS TENUISECTA* A. Gray—(Figure 8).  $2n = 24, 48$ . Wool waste. From farther west.

*Bidens trichosperma* (Michaux) Britton—Tickseed-sunflower (Figure 8).  $2n = 24$ . Meadows, swamps, bogs. [*B. coronata* (Linnaeus) Britton – invalid name; *B. coronata* (Linnaeus) Britton var. *brachyodonta* Fernald]

*Bidens tripartita* Linnaeus—(Figure 8).  $2n = 48$ . Marshes, meadows, shores, other wet sites. [*B. comosa* (A. Gray) Wiegand]

*Bidens vulgata* Greene—Tall Beggar-ticks (Figure 9).  $2n = 24, 48$ . Low ground, ditches, roadsides, waste places, often in moist soil.

— *Bidens* hybrids —

*Bidens cernua* Linnaeus × *B. connata* Muhlenberg ex Willdenow—(Figure 9).

*Bidens cernua* Linnaeus × *B. hyperborea* Greene—(Figure 9).

*Bidens connata* Muhlenberg ex Willdenow × *B. tripartita* Linnaeus—(Figure 9).

*Bidens* × *multiceps* Fassett—(Figure 9). [*B. connata* Muhlenberg ex Willdenow × *B. eatonii* Fernald]

*BOLTONIA ASTEROIDES* (Linnaeus) L'Héritier var. *LATISQUAMA* (A. Gray) Cronquist—(Figure 9).  $2n = 18$ . Waste places, roadsides. From farther west. [*B. LATISQUAMA* A. Gray var. *LATISQUAMA*]

*BOLTONIA ASTEROIDES* (Linnaeus) L'Héritier var. *RECOGNITA* (Fernald & Griscom) Cronquist—(Figure 9).  $2n = 36$ . Waste places. From farther west. [*B. LATISQUAMA* A. Gray var. *RECOGNITA* Fernald & Griscom]

*CALENDULA OFFICINALIS* Linnaeus—Pot Marigold (Figure 9).  $2n = 14, 32$ . Waste places. Probably from the Mediterranean region.

*CALLISTEPHUS CHINENSIS* (Linnaeus) Nees—China Aster (Figure 9).  $2n = 18$ . Fields, sandy, pond shores. From eastern Asia.

- CALOTIS CUNEIFOLIA* R. Brown—Purple Burr-daisy (Figure 10).  $2n = 16, 32$ . Wool waste. From Australia.
- CARDUUS ACANTHOIDES* Linnaeus subsp. *ACANTHOIDES*—Plumeless Thistle (Figure 10).  $2n = 22$ . Roadsides, waste places, fields. From Eurasia.
- CARDUUS CRISPUS* Linnaeus—Wetted Thistle (Figure 10).  $2n = 16$  (Sweden). Roadsides, waste places, fields. From Eurasia.
- CARDUUS NUTANS* Linnaeus—Musk Thistle (Figure 10).  $2n = 16$ . Roadsides, waste places, fields. From Eurasia.
- CARTHAMUS TINCTORIUS* Linnaeus—Safflower (Figure 10).  $2n = 24$ . Waste areas. Probably from western Asia.
- CENTAUREA BENEDICTA* (Linnaeus) Linnaeus—Blessed Thistle (Figure 10).  $2n = 22$ . Waste places, roadsides. From Mediterranean region, Asia Minor. [*CNICUS BENEDICTUS* Linnaeus]
- CENTAUREA CALCITRAPA* Linnaeus—Purple Star-thistle (Figure 10).  $2n = 20$ . Roadsides, waste places, fields. From Eurasia, northern Africa.
- CENTAUREA CYANUS* Linnaeus—Cornflower (Figure 10).  $2n = 24$  (Russia). Roadsides, waste places, fields. From Eurasia.
- CENTAUREA DIFFUSA* Lamarck—(Figure 10).  $2n = 18, 36$ . Roadsides, waste places, fields. From Eurasia.
- CENTAUREA JACEA* Linnaeus—Brown Knapweed (Figure 11).  $2n = 22, 44$ . Roadsides, waste places, fields. From Eurasia. [*C. AMARA* Linnaeus]
- CENTAUREA MELITENSIS* Linnaeus—Tocalote (Figure 11).  $2n = 24$ . Waste places. From the Mediterranean region.
- CENTAUREA MONTANA* Linnaeus—Mountain-bluet (Figure 11).  $2n = 24$  (Germany), 40 (Russia), 44 (France). Railroads, roadsides, waste places. From Europe.
- CENTAUREA NIGRA* Linnaeus—Spanish-buttons (Figure 11).  $2n = 22, 44$ . Fields, roadsides, waste places. From Europe.
- CENTAUREA NIGRESCENS* Willdenow—Tyrol Knapweed (Figure 11).  $2n = 22$  (Hungary), 44 (Hungary, Italy). Fields, roadsides, waste places. From Eurasia. [*C. DUBIA* Suter – misapplied; *C. VOCHINENSIS* Bernhadi ex Reichenbach]
- CENTAUREA SCABIOSA* Linnaeus—Greater Knapweed (Figure 11).  $2n = 20$  (Russia), 40. Meadows, fields, roadsides, railroads. From Europe.
- CENTAUREA SOLSTITIALIS* Linnaeus—Yellow Star-thistle (Figure 11).  $2n = 16$ . Fields, roadsides, waste places. From Eurasia, northern Africa.

*CENTAUREA STOEBE* Linnaeus subsp. *MICRANTHOS* (S.G. Gmelin *ex* Gugler) Hayek—(Figure 11).  $2n = 36$ . Fields, roadsides, waste places. From Europe. [*C. MACULOSA* Lamarck – misapplied]

—*Centaurea* hybrid—

*CENTAUREA* × *MONCKTONII* C.E. Britton—(Figure 11). [*C. NIGRA* Linnaeus var. *RADIATA* de Candolle; *C. PRATENSIS* illegitimate name; *C. JACEA* Linnaeus × *C. NIGRA* Linnaeus]

*CHAENACTIS GLABRIUSCULA* de Candolle var. *GLABRIUSCULA*—(Figure 12).  $2n = 12$ . Wool waste. From farther west.

*CHAMAEMELUM NOBILE* (Linnaeus) Allioni—Garden Chamomile (Figure 12).  $2n = 18$ . Dry, oak woods, disturbed sites. From Europe, northern Africa. [*ANTHEMIS NOBILIS* Linnaeus]

*Chrysopsis mariana* (Linnaeus) Elliott—Maryland Golden-aster (Figure 12).  $2n = 8, 16, 24, 32$ . Dry, sandy fields, roadsides.

*CICHORIUM ENDIVIA* Linnaeus—Endive (Figure 12).  $2n = 18$ . Waste places. From Eurasia, northern Africa.

*CICHORIUM INTYBUS* Linnaeus—Common Chicory (Figure 12).  $2n = 18$ . Fields, roadsides. From Eurasia, northern Africa.

*Cirsium altissimum* (Linnaeus) Sprengel—Roadside Thistle (Figure 12).  $2n = 18$ . Fields, thickets.

*CIRSIIUM ARVENSE* (Linnaeus) Scopoli—Canada Thistle (Figure 12).  $2n = 34$ . Fields, roadsides, waste places. From Eurasia. [*C. ARVENSE* var. *INTEGRIFOLIUM* Wimmer & Grabowski; *C. ARVENSE* var. *MITE* Wimmer & Grabowski; *C. ARVENSE* var. *VESTITUM* Wimmer & Grabowski]

*Cirsium discolor* (Muhlenberg *ex* Willdenow) Sprengel—Field Thistle (Figure 12).  $2n = 20, 21, 22$ . Moist thickets, damp woods, shores, meadows.

*CIRSIIUM FLODMANII* (Rydberg) Arthur—(Figure 12).  $2n = 22, 24$ . Dry pastures. From farther west.

*Cirsium horridulum* Michaux var. *horridulum*—Yellow Thistle (Figure 13).  $2n = 32, 34$ . Fields, meadows, shores, roadsides, wood borders, usually in wet and often saline soil.

*Cirsium muticum* Michaux—Swamp Thistle (Figure 13).  $2n = 20, 21, 22, 23, 30$ . Swamps, wet thickets, low, wet woods.

*CIRSIIUM OCHROCENTRUM* A. Gray var. *OCHROCENTRUM*—(Figure 13).  $2n = 32, 34$ . Pastures. From farther west.

*CIRSIIUM PALUSTRE* (Linnaeus) Scopoli—(Figure 13).  $2n = 34$ . Waste places. From Europe.

*Cirsium pumilum* (Nuttall) Sprengel var. *pumilum*—Pasture Thistle (Figure 13).  $2n = 30$ . Fields, roadsides, dry, open soil.

- CIRSIUM VULGARE* (Savi) Tenore—Bull Thistle (Figure 13).  $2n = 68$ . Fields, roadsides, waste places. From Eurasia, northern Africa.
- CONYZA BONARIENSIS* (Linnaeus) Cronquist—Hairy Fleabane (Figure 13).  $2n = 54$ . Waste. Probably from South America. [*ERIGERON BONARIENSIS* Linnaeus]
- Conyza canadensis* (Linnaeus) Cronquist—Horseweed (Figure 13).  $2n = 18$ . Fields, roadsides, waste places. [*Erigeron canadensis* Linnaeus; *E. pusillus* Nuttall]
- COREOPSIS BASALIS* (A. Dietrich) S. F. Blake—(Figure 13).  $2n = 26$ . Roadsides, waste places. From farther south. [*C. DRUMMONDII* Torrey & A. Gray]
- COREOPSIS GRANDIFLORA* Hogg ex Sweet—(Figure 14).  $2n = 26 (+ 0-2B)$ . Fields, roadsides, waste places. From farther south and west. [*C. GRANDIFLORA* var. *HARVEYANA* (A. Gray) Sherff]
- COREOPSIS LANCEOLATA* Linnaeus—Sand Coreopsis (Figure 14).  $2n = 26 (+ 0-4B)$ . Dry, sandy fields, roadsides. From farther south and west. [*C. LANCEOLATA* var. *VILLOSA* Michaux]
- COREOPSIS MAJOR* Walter—Wood Tickseed (Figure 14).  $2n = 26, 78, 104$ . Waste places. From farther south. [*C. MAJOR* var. *STELLATA* (Nuttall) B. L. Robinson]
- COREOPSIS PUBESCENS* Elliott—Star Tickseed (Figure 14).  $2n = 26 (+ 0-2B)$ . Fields, waste places. From farther south. [*C. PUBESCENS* var. *ROBUSTA* A. Gray ex Eames]
- Coreopsis rosea* Nuttall—Pink Tickseed (Figure 14).  $2n = 26$ . Sandy, pond shores.
- COREOPSIS TINCTORIA* Nuttall—Garden Tickseed (Figure 14).  $2n = 24 (+ 0-2B)$ . Waste places, roadsides, wetland margins. From farther west and south.
- COREOPSIS TRIPTERIS* Linnaeus—Tall Coreopsis (Figure 14).  $2n = 26$ . Roadsides. From farther west and south.
- COREOPSIS VERTICILLATA* Linnaeus—(Figure 14).  $2n = 26, 52, 78$ . Roadsides. From farther south.
- COSMOS BIPINNATUS* Cavanilles—Garden Cosmos (Figure 14).  $2n = 24$ . Waste places, roadsides. From Mexico and the southwestern United States.
- COSMOS PARVIFLORUS* (Jacquin) Persoon—(Figure 15).  $2n = 24$ . Waste places, roadsides. From the southwestern United States.
- COSMOS SULPHUREUS* Cavanilles—Orange Cosmos (Figure 15).  $2n = 24, 48$ . Waste places. From Mexico.
- COTA TINCTORIA* (Linnaeus) J. Gay ex Gussone—Yellow Chamomile (Figure 15).  $2n = 18$ . Fields, waste places, roadsides. From Eurasia. [*ANTHEMIS TINCTORIA* Linnaeus]
- COTULA CORONOPIFOLIA* Linnaeus—Brass-buttons (Figure 15).  $2n = 20$ . Ballast waste. From South Africa.
- CREPIS BIENNIS* Linnaeus—Rough Hawk's-beard (Figure 15).  $2n = 40$ . Fields. From Europe.



- CREPIS CAPILLARIS* (Linnaeus) Wallroth—Smooth Hawk's-beard (Figure 15).  $2n = 6$ . Fields, waste places, roadsides. From Europe. [*C. VIRENS* Linnaeus]
- CREPIS FOETIDA* Linnaeus—Stinking Hawk's-beard (Figure 15).  $2n = 10$ . Wool waste. From Eurasia, northern Africa.
- CREPIS NICAENSIS* Balbis—French Hawk's-beard (Figure 15).  $2n = 8$ . Waste places. From Europe.
- CREPIS SETOSA* Haller f.—Bristly Hawk's-beard (Figure 15).  $2n = 8$ . Fields. From Eurasia.
- CREPIS TECTORUM* Linnaeus—(Figure 16).  $2n = 8$ . Waste places, fields, roadsides, meadows, open, sandy, disturbed areas. From Eurasia.
- CREPIS VESICARIA* Linnaeus—Beaked Hawk's-beard (Figure 16).  $2n = 8, 16$ . Fields. From Europe, northern Africa. [*C. VESICARIA* subsp. *TARAXACIFOLIA* (Thuiller) Thellung]
- CYCLACHAENA XANTHIIFOLIA* (Nuttall) Fresenius—Giant Sumpweed (Figure 16).  $2n = 36$ . Waste places, fields. From farther west. [*IVA XANTHIIFOLIA* Nuttall]
- DEINANDRA FASCICULATA* (de Candolle) Greene—(Figure 16).  $2n = 24$ . Wool waste. From farther west. [*HEMIZONIA FASCICULATA* de Candolle; *H. FASCICULATA* subsp. *RAMOSISSIMA* (Benth) D. D. Keck; *H. RAMOSISSIMA* Benth]
- DITTRICHIA GRAVEOLENS* (Linnaeus) Greuter—Stinkwort (Figure 16).  $2n = 18$  (Morocco). Sandy, open, disturbed sites. From Eurasia, northern Africa. [*INULA GRAVEOLENS* (Linnaeus) Desfontaines]
- Doellingeria infirma* (Michaux) Greene—Appalachian Flat-top Aster (Figure 16).  $2n = 18$ . Dry, open, deciduous, rocky woods. [*Aster infirmus* Michaux]
- Doellingeria umbellata* (Miller) Nees var. *umbellata*—Tall Flat-top White Aster (Figure 16).  $2n = 18$ . Moist thickets and openings, meadows, swamps, bogs. [*Aster umbellatus* Miller]
- DORONICUM PARDALIANCHES* Linnaeus—Great Leopard's-bane (Figure 16).  $2n = 60$ . Open, disturbed ground. From Europe.
- DYSSODIA PAPPOSA* (Ventenat) A. Hitchcock—Fetid Marigold (Figure 16).  $2n = 26$ . Wool waste, roadsides, gravelly, river shores. From farther west.
- ECHINACEA PALLIDA* (Nuttall) Nuttall—(Figure 17).  $2n = 22$ . Fields, roadsides. From farther west.
- ECHINACEA PURPUREA* (Linnaeus) Moench—Eastern Purple Coneflower (Figure 17).  $2n = 22$ . Dry roadsides, wood margins. From farther south and west.
- ECHINOPS SPHAEROCEPHALUS* Linnaeus—Common Globe-thistle (Figure 17).  $2n = 30, 32$ . Waste places, roadsides, fields. From Eurasia.
- ECLIPTA PROSTRATA* (Linnaeus) Linnaeus—Yerba-de-Tajo (Figure 17).  $2n = 22$ . Waste places. From farther south and west. [*E. ALBA* (Linnaeus) Hasskarl]

- Erechtites hieracifolius* (Linnaeus) Rafinesque ex de Candolle var. *hieracifolius*—Pilewort (Figure 17).  $2n = 40$ . Damp thickets, clearings (especially burned areas), waste places, shores. [*E. hieracifolius* var. *intermedius* Fernald; *E. hieracifolius* var. *prealtus* (Rafinesque) Fernald]
- Erechtites hieracifolius* (Linnaeus) Rafinesque ex de Candolle var. *megalocarpus* (Fernald) Cronquist—Saltmarsh Pilewort (Figure 17).  $2n = ?$  Salt marshes, sandy, sea beaches. [*E. megalocarpus* Fernald]
- Erigeron acris* Linnaeus var. *kamtschaticus* (de Candolle) Herder—(Figure 17).  $2n = 18$ . Damp banks, thickets, clearings, roadsides. [*E. angulosus* Gaudin var. *kamtschaticus* (de Candolle) H. Hara – misapplied]
- Erigeron annuus* (Linnaeus) Persoon—Daisy Fleabane (Figure 17).  $2n = 27$ . Roadsides, fields, waste places.
- ERIGERON GLABELLUS* Nuttall var. *PUBESCENS* Hooker—Streamside Fleabane (Figure 17).  $2n = ?$  Swamps. From farther west.
- Erigeron hyssopifolius* Michaux—(Figure 18).  $2n = 18$ . Rocky ledges.
- Erigeron philadelphicus* Linnaeus var. *philadelphicus*—Common Fleabane (Figure 18).  $2n = 18$ . Open woods, wood margins, fields, rich thickets, roadsides.
- Erigeron philadelphicus* Linnaeus var. *provancheri* (Victorin & J. Rousseau) B. Boivin—(Figure 18).  $2n = 18$ . Sandy crevices in shale receiving splashed water of river falls. [*E. provancheri* Victorin & J. Rousseau]
- Erigeron pulchellus* Michaux var. *pulchellus*—Robin's-plantain (Figure 18).  $2n = 9, 18$ . Fields, open woods, roadsides.
- Erigeron strigosus* Muhlenberg ex Willdenow var. *strigosus*—Lesser Daisy-fleabane (Figure 18).  $2n = 18, 27, 36, 54$ . Dry, open soil, fields, roadsides. [*E. strigosus* var. *beyrichii* (Fischer & C. A. Meyer) Torrey & A. Gray; *E. strigosus* var. *discondens* Robbins]
- Erigeron strigosus* Muhlenberg ex Willdenow var. *septentrionalis* (Fernald & Wiegand) Fernald—Lesser Daisy-fleabane (Figure 18).  $2n = ?$  Dry, open soil, fields, roadsides.
- Eupatorium album* Linnaeus var. *album*—(Figure 18).  $2n = 20$ . Dry, open, disturbed soil.
- EUPATORIUM ALTISSIMUM* Linnaeus—(Figure 18).  $2n = 20, 30, 40$ . Roadsides, waste places. From farther west and south.
- Eupatorium hyssopifolium* Linnaeus var. *hyssopifolium*—Justice-weed (Figure 18).  $2n = 20, 30$ . Dry, sandy fields, dry, open woods and clearings, roadsides. [*E. hyssopifolium* var. *calcaratum* Fernald & B. G. Schubert]
- Eupatorium hyssopifolium* Linnaeus var. *laciniatum* A. Gray—(Figure 19).  $2n = 30, 40$ . Roadsides.
- Eupatorium perfoliatum* Linnaeus—Boneset (Figure 19).  $2n = 20$ . Low woods, shores, swamps. [*E. perfoliatum* var. *colpophilum* Fernald & Griscom]

*Eupatorium pilosum* Walter—(Figure 19).  $2n = 20, 30, 40$ . Low woods, shores, swamps, moist, low ground. [*E. rotundifolium* Linnaeus var. *saundersii* (Porter ex Britton) Cronquist]

*Eupatorium rotundifolium* Linnaeus var. *rotundifolium*—Round-leaved Thoroughwort (Figure 19).  $2n = 20, 30$ . Open woods, clearings.

*Eupatorium rotundifolium* Linnaeus var. *ovatum* (Bigelow) Torrey ex de Candolle—Round-leaved Thoroughwort (Figure 19).  $2n = 20, 30$ . Dry, open woods, clearings, roadsides.

*EUPATORIUM SEROTINUM* Michaux—(Figure 19).  $2n = 20$ . Roadsides, railroad yard, fields. From farther west and south.

*Eupatorium sessilifolium* Linnaeus—Upland Boneset (Figure 19).  $2n = 20, 30$ . Rocky, open woods. [*E. sessilifolium* var. *brittonianum* Porter]

—*Eupatorium* hybrid—

*Eupatorium* × *novae-angliae* (Fernald) V. Sullivan ex A. Haines & Sorrie (*pro species*)—(Figure 19). [*E. PALUDICOLA* E. E. Schilling & LeBlond × *E. perfoliatum* Linnaeus]

*Eurybia divaricata* (Linnaeus) G.L. Nesom—White Wood Aster (Figure 19).  $2n = 18$ . Rich, deciduous woods, clearings, roadsides. [*Aster divaricatus* Linnaeus]

*Eurybia macrophylla* (Linnaeus) Cassini—(Figure 20).  $2n = 72$ . Open woods, thickets, clearings, roadsides. [*Aster macrophyllus* Linnaeus var. *macrophyllus*; *A. macrophyllus* var. *apricensis* E.S. Burgess; *A. macrophyllus* var. *excelsior* E.S. Burgess; *A. macrophyllus* var. *ianthinus* (E.S. Burgess) Fernald; *A. macrophyllus* var. *pinguifolius* E.S. Burgess; *A. macrophyllus* var. *sejunctus* E.S. Burgess; *A. macrophyllus* var. *velutinus* E.S. Burgess]

*Eurybia radula* (Aiton) G.L. Nesom—(Figure 20).  $2n = 18$ . *Sphagnum* bogs, boggy shores, swamps, low woods. [*Aster radula* Aiton var. *radula*; *A. radula* Aiton var. *strictus* A. Gray]

*Eurybia schreberi* (Nees) Nees—(Figure 20).  $2n = 54$ . Rich, deciduous or mixed woods, thickets. [*Aster glomeratus* Bernhardt ex Nees; *A. macrophyllus* Linnaeus var. *schreberi* (Nees) F. Seymour; *A. schreberi* Nees]

*Eurybia spectabilis* (Aiton) G.L. Nesom—Seaside Purple Aster (Figure 20).  $2n = 72$ . Dry, sandy, open woods and clearings, roadsides. [*Aster spectabilis* Aiton]

—*Eurybia* hybrid—

*Eurybia* × *herveyi* (A. Gray) G.L. Nesom (*pro species*)—(Figure 20). [*E. macrophylla* (Linnaeus) Cassini × *E. spectabilis* (Aiton) G. L. Nesom; *Aster herveyi* A. Gray]

*Euthamia caroliniana* (Linnaeus) Greene ex Porter & Britton—Quobsque-weed (Figure 20).  $2n = 18$ . Sandy shores, open, sandy soils. [*E. microcephala* Greene; *Solidago microcephala* Bush; *S. tenuifolia* Pursh var. *tenuifolia*; *S. tenuifolia* var. *pynchocephala* Fernald]

*Euthamia graminifolia* (Linnaeus) Nuttall—Common Flat-topped Goldenrod (Figure 20).  $2n = 18$ . Shores, beaches, salt marsh borders, fields. [*Solidago graminifolia* (Linnaeus) Salisbury var. *graminifolia*; *S. graminifolia* var. *nuttallii* (Greene) Fernald; *S. graminifolia* var. *polyccephala* Fernald]

*Eutrochium dubium* (Willdenow ex Poiret) E.E. Lamont—Eastern Joe-pye-weed (Figure 20).  $2n = 20$ . Meadows, shores, low, moist, acid soil. [*Eupatorium dubium* Willdenow ex Poiret]

*Eutrochium fistulosum* (Barratt) E.E. Lamont—Trumpetweed (Figure 20).  $2n = 20$ . Moist thickets, meadows, alluvial woods. [*Eupatorium fistulosum* Barratt]

*Eutrochium maculatum* (Linnaeus) E.E. Lamont var. *maculatum*—(Figure 21).  $2n = 20$ . Moist thickets, meadows, shores, usually in rich or calcareous soil. [*Eupatorium maculatum* Linnaeus var. *maculatum*]

*Eutrochium maculatum* (Linnaeus) E.E. Lamont var. *foliosum* (Fernald) E. E. Lamont—(Figure 21).  $2n = 20$ . Moist thickets, meadows, shores, usually in rich or calcareous soil. [*Eupatorium maculatum* Linnaeus var. *foliosum* (Fernald) Wiegand]

*Eutrochium purpureum* (Linnaeus) E.E. Lamont var. *purpureum*—Sweet Joe-pye-weed (Figure 21).  $2n = 20$ . Rich, deciduous, chiefly calcareous woods. [*Eupatorium purpureum* Linnaeus var. *purpureum*]

*FILAGO VULGARIS* Lamarck—Herba Impia (Figure 21).  $2n = 28$  (British Isles, Bulgaria, Czechoslovakia, Greece). From Eurasia, northern Africa. [*FILAGO GERMANICA* Linnaeus]

*FLAVERIA BIDENTIS* (Linnaeus) Kuntze—Coastal Plain Yellowtops (Figure 21).  $2n = 36$ . Wool waste. From South America.

*GAILLARDIA PULCHELLA* Fougereux—Firewheel (Figure 21).  $2n = 34$ . Waste places, roadsides, dry, sandy open places. From farther west. [*G. PULCHELLA* var. *PICTA* (D. Don) A. Gray; *G. PICTA* D. Don]

—*Gaillardia* hybrid—

*GAILLARDIA* × *GRANDIFLORA* Van Houtte (*pro species*)—(Figure 21). [*G. ARISTATA* Pursh × *G. PULCHELLA* Fougereux]

*GALINSOGA PARVIFLORA* Cavanilles var. *PARVIFLORA*—Gallant Soldier (Figure 21).  $2n = 16$ . Waste places, roadsides, fields. From Mexico, West Indies, Central & South America.

*GALINSOGA QUADRIRADIATA* Ruiz & Pavón—Shaggy Soldier (Figure 21).  $2n = 16, 32 (+ 0-2B)$ . Waste places, roadsides, fields. From Mexico, West Indies, Central & South America. [*G. BICOLORATA* H. St. John & D. White; *G. CARACASANA* (de Candolle) Schultz-Bipontinus; *G. CILLATA* (Rafinesque) S. F. Blake; *G. PARVIFLORA* Cavanilles var. *HISPIDA* de Candolle]

*GAMOCOAETA PENNSYLVANICA* (Willdenow) Cabrera—(Figure 22).  $2n = 28$ . Waste places, roadsides, fields. From Mexico, Central & South America. [*GNAPHALIUM PEREGRINUM* Fernald]

*Gamochaeta purpurea* (Linnaeus) Cabrera—Purple Cudweed (Figure 22).  $2n = 14, 28$ . Dry fields, sandy openings, waste places, roadsides. [*Gnaphalium purpureum* Linnaeus]

*GLEBIONIS CORONARIA* (Linnaeus) Cassini ex Spach—Garland Chrysanthemum (Figure 22).  $2n = 18$ . Waste places. From Eurasia, northern Africa. [*CHRYSANTHEMUM CORONARIUM* Linnaeus]

- GLEBIONIS SEGETUM* (Linnaeus) Fourreau—Corn Marigold (Figure 22).  $2n = 18$ . Waste places, roadsides. From Eurasia, northern Africa. [*CHRYSANTHEMUM SEGETUM* Linnaeus]
- Gnaphalium uliginosum* Linnaeus—Low Cudweed (Figure 22).  $2n = 14$ . Roadside ditches, damp clearings, meadows, waste places.
- GRINDELLA HIRSUTULA* Hooker & Arnott—(Figure 22).  $2n = 12, 24$ . Waste places. From farther west. [*G. SQUARROSA* (Pursh) Dunal var. *QUASIPERENNIS* Lunell]
- GRINDELLA LANCEOLATA* Nuttall—(Figure 22).  $2n = 12$ . Roadsides. From farther south and west.
- GRINDELLA SQUARROSA* (Pursh) Dunal—(Figure 22).  $2n = 12$ . Waste places, roadsides. From farther west. [*G. SQUARROSA* var. *SERRULATA* (Rydberg) Steyermark]
- GUIZOTIA ABYSSINICA* (Linnaeus f.) Cassini—Niger Seed (Figure 22).  $2n = 30$  (India). Waste places, roadsides. From tropical Africa.
- Hasteola suaveolens* (Linnaeus) Pojarkova—(Figure 23).  $2n = 20$ . Stream banks, thickets, rich woods. [*C. suaveolens* Linnaeus]
- HELENIUM AMARUM* (Rafinesque) H. Rock var. *AMARUM*—Yellowdicks (Figure 23).  $2n = 30$ . Waste places, railroads. From farther south. [*H. TENUIFOLIUM* Nuttall]
- Helenium autumnale* Linnaeus—Common Sneezeweed (Figure 23).  $2n = 32, 34, 36$ . Shores, meadows. [*H. autumnale* var. *canaliculatum* (Lamarck) Torrey & A. Gray; *H. autumnale* var. *parviflorum* (Nuttall) Fernald]
- HELENIUM FLEXUOSUM* Rafinesque—Purplehead Sneezeweed (Figure 23).  $2n = 28$ . Meadows, shores, fields. From farther south. [*H. NUDIFLORUM* Nuttall]
- HELLANTHUS ANNUUS* Linnaeus—Common Sunflower (Figure 23).  $2n = 34$ . Waste places, roadsides. From farther west.
- HELLANTHUS DEBILIS* Nuttall subsp. *CUCUMERIFOLIUS* (Torrey & A. Gray) Heiser—(Figure 23).  $2n = 34$ . Waste places, fields. From farther south.
- Helianthus decapetalus* Linnaeus—(Figure 23).  $2n = 34, 68$ . Open woods, thickets, often moist soil near streams, roadsides. [*H. trachelifolius* Miller]
- Helianthus divaricatus* Linnaeus—Woodland Sunflower (Figure 23).  $2n = 34$ . Dry, thickets, woods, and openings, roadsides. [*H. divaricatus* var. *angustifolius* Kuntze]
- Helianthus giganteus* Linnaeus—(Figure 23).  $2n = 34$ . Dry fields, salt marsh borders, usually wet, open sites.
- HELLANTHUS GROSSESERRATUS* M. Martens—(Figure 24).  $2n = 34$ . Roadsides, sandy fields, rich thickets. From farther west.
- HELLANTHUS MAXIMILLANI* Schrader—(Figure 24).  $2n = 34$ . Waste places, fields. From farther west. [*H. dalyi* Britton]

*HELLANTHUS MOLLIS* Lamarck—Ashy Sunflower (Figure 24).  $2n = 34$ . Dry, sandy fields, roadsides, waste places. From farther south and west.

*HELLANTHUS PAUCIFLORUS* Nuttall subsp. *PAUCIFLORUS*—(Figure 24).  $2n = ?$ . Dry, sandy fields, waste places. From farther west. [*H. LAETIFLORUS* Persoon var. *RIGIDUS* (Cassini) Fernald]

*HELLANTHUS PAUCIFLORUS* Nuttall subsp. *SUBRHOMBOIDEUS* (Rydberg) O. Spring & E. E. Schilling—(Figure 24).  $2n = ?$ . Roadsides, waste places. From farther west. [*H. LAETIFLORUS* Persoon var. *SUBRHOMBOIDEUS* (Rydberg) Fernald]

*HELLANTHUS PETIOLARIS* Nuttall subsp. *PETIOLARIS*—Prairie Sunflower (Figure 24).  $2n = 34$ . Dry roadsides, waste places. From farther west.

*Helianthus strumosus* Linnaeus—(Figure 24).  $2n = 68, 102$ . Thickets, open woods, clearings, roadsides.

*HELLANTHUS TUBEROSUS* Linnaeus—Jerusalem Artichoke (Figure 24).  $2n = 102$ . Waste places, roadsides, fields. From farther west and south. [*H. TUBEROSUS* var. *SUBCANESCENS* A. Gray]

—*Helianthus* hybrids—

*Helianthus* × *ambiguus* (Torrey & A. Gray) Britton (*pro species*)—(Figure 24). [*H. divaricatus* Linnaeus × *H. giganteus* Linnaeus]

*HELLANTHUS* × *DIVARISERRATUS* R.W. Long—(Figure 25). [*H. divaricatus* Linnaeus × *H. GROSSESERRATUS* M. Martens]

*HELLANTHUS* × *DORONICOIDES* Lamarck (*pro species*)—(Figure 25). [*H. giganteus* Linnaeus × *H. MOLLIS* Lamarck]

*HELLANTHUS* × *INTERMEDIUS* R.W. Long—(Figure 25). [*H. GROSSESERRATUS* M. Martens × *H. MAXIMILLANI* Schrader]

*HELLANTHUS* × *KELLERMANII* Britton (*pro species*)—(Figure 25). [*H. GROSSESERRATUS* M. Martens × *H. SALICIFOLIUS* A. Dietrich]

*HELLANTHUS* × *LAETIFLORUS* Persoon (*pro species*)—(Figure 25). [*H. PAUCIFLORUS* Nuttall × *H. TUBEROSUS* Linnaeus]

*HELLANTHUS* × *LUXURIANS* E. Watson (*pro species*)—(Figure 25). [*H. giganteus* Linnaeus × *H. GROSSESERRATUS* M. Martens]

*HELIOMERIS MULTIFLORA* Nuttall var. *MULTIFLORA*—(Figure 25).  $2n = 16$ . Wool waste. From farther west.

*HELIOPSIS HELIANTHOIDES* (Linnaeus) Sweet var. *HELIANTHOIDES*—False Sunflower (Figure 25).  $2n = ?$ . Fields, waste places, thickets. From farther west and south.

*HELIOPSIS HELIANTHOIDES* (Linnaeus) Sweet var. *SCABRA* (Dunal) Fernald—(Figure 25).  $2n = ?$ . Fields, waste places, thickets. From farther west.

*HELMINTHOTHECA ECHIOIDES* (Linnaeus) Holub—Oxtongue (Figure 26).  $2n = 10$ . Fields, waste places, roadsides. From Eurasia, northern Africa. [*PICRIS ECHIOIDES* Linnaeus]

*HETEROSPERMA PINNATUM* Cavanilles—Wingpetal (Figure 26).  $2n = 48, 50$ . Wool waste. From farther west.

*HETEROTHECA SUBAXILLARIS* (Lamarck) Britton & Rusby subsp. *LATIFOLIA* (Buckley) Semple—(Figure 26).  $2n = 18$ . Roadsides. From farther south.

*HIERACIUM AURANTIACUM* Linnaeus—Devil's Paintbrush (Figure 26).  $2n = 30, 36, 45, 54, 63$ . Fields, clearings, roadsides. From Europe.

*HIERACIUM CAESPITOSUM* Dumortier—Yellow Fox-and-cubs (Figure 26).  $2n = 18, 36, 45$ . Fields, clearings, roadsides. From Europe. [*H. PRATENSE* Tausch]

*HIERACIUM FLAGELLARE* Willdenow—(Figure 26).  $2n = 26, 45, 54$ . Waste places, roadsides, fields. From Europe.

*Hieracium gronovii* Linnaeus—(Figure 26).  $2n = 18$ . Dry fields, open pine or pine-oak woods, dry openings, roadsides.

*HIERACIUM LACHENALII* Suter—European Hawkweed (Figure 26).  $2n = 27, 36$ . Roadsides, thickets, openings in woods. From Europe. [*H. VULGATUM* Fries]

*HIERACIUM MACULATUM* Schrank—(Figure 26).  $2n = 36$ . Calcareous till. From Europe.

*HIERACIUM MURORUM* Linnaeus—Golden Lungwort (Figure 27).  $2n = 27, 36$ . Roadsides, fields, thickets, openings in woods. From Eurasia.

*Hieracium paniculatum* Linnaeus—Allegheny Hawkweed (Figure 27).  $2n = 18$ . Dry, often rocky, open woods, roadsides.

*HIERACIUM PILOSELLA* Linnaeus—Mouse-ear Hawkweed (Figure 27).  $2n = 18, 36, 45, 54, 63, 72, 81, 90$ . Dry, open soil, fields, roadsides. From Eurasia. [*H. PILOSELLA* var. *NIVEUM* Müller Argovicensis]

*HIERACIUM PILOSELLOIDES* Villars—Glaucous King Devil (Figure 27).  $2n = 18, 36$ . Fields, roadsides, clearings. From Eurasia. [*H. FLORENTINUM* Allioni]

*HIERACIUM PRAEALTUM* Villars ex Gochnat—(Figure 27).  $2n = 45$ . Fields, meadows, roadsides. From Europe. [*H. PRAEALTUM* var. *DECIPIENS* W. D. J. Koch]

*Hieracium robinsonii* (Zahn) Fernald—(Figure 27).  $2n = 27$ . Ledge crevices, rocky shores.

*HIERACIUM SABAUDUM* Linnaeus—(Figure 27).  $2n = 18, 27, 36$ . Roadsides, waste places, fields. From Eurasia.

*Hieracium scabrum* Michaux—Sticky Hawkweed (Figure 27).  $2n = 18$ . Dry, open woods, fields, clearings, roadsides. [*H. scabrum* var. *tonsum* Fernald & H. St. John]

*Hieracium umbellatum* Linnaeus—Northern Hawkweed (Figure 27).  $2n = 18, 27$ . Dry, open woods, fields, woods margins, shores, thickets, clearings, roadsides. [*H. canadense* Michaux var.

*canadense*; *H. canadense* var. *fasciculatum* (Pursh) Fernald; *H. canadense* var. *hirtitraceum* Fernald; *H. kalmii* Linnaeus]

*Hieracium venosum* Linnaeus—Rattlesnake-weed (Figure 28).  $2n = 18$ . Dry, open, sandy woods, fields, clearings. [*H. venosum* var. *rudiculae* (Michaux) Farwell]

—*Hieracium* hybrids—

*HIERACIUM* × *ATRAMENTARIUM* (Nägeli & Peter) Zahn ex Engelmann (*pro species*)—(Figure 28). [*H. AURANTIACUM* Linnaeus × *H. PILOSELLOIDES* Villars]

*Hieracium* × *fassetii* Lepage—(Figure 28). [*H.* × *fernaldii* Lepage; *H. scabrum* Michaux × *H. umbellatum* Linnaeus]

*HIERACIUM* × *FLORIBUNDUM* Wimmer & Grabowski (*pro species*)—(Figure 28). [*H. CAESPITOSUM* Dumortier × *H. LACTUCELLA* Wallroth]

*HIERACIUM* × *FUSCOATRUM* Nägeli & Peter—(Figure 28). [*H. AURANTIACUM* Linnaeus × *H. CAESPITOSUM* Dumortier]

*Hieracium* × *marianum* Willdenow (*pro species*)—(Figure 28). [*H. gronovii* Linnaeus or *H. scabrum* Michaux × *H. venosum* Linnaeus]

*HYMENOXYIS ODORATA* de Candolle—Bitter Rubberweed (Figure 28).  $2n = 22, 24, 28, 30$ . Waste places. From farther west.

*HYPOCHAERIS GLABRA* Linnaeus—(Figure 28).  $2n = 8, 10, 12$ . Wool waste, fields. From Eurasia, northern Africa.

*HYPOCHAERIS RADICATA* Linnaeus—Common Cat's-ear (Figure 28).  $2n = 8$ . Roadsides, fields, waste places. From Eurasia, northern Africa.

*INULA HELENIUM* Linnaeus—Elecampane (Figure 29).  $2n = 20$ . Damp fields, roadsides, clearings, waste places. From Eurasia.

*Ionactis linariifolia* (Linnaeus) Greene—Stiff Aster (Figure 29).  $2n = 18$ . Dry, open, sandy soil, woods borders, rocky outcrops. [*Aster linariifolius* Linnaeus]

*IVA ANNUA* Linnaeus—Sumpweed (Figure 29).  $2n = 34$ . Waste places. From farther west and south. [*I. CILLATA* Willdenow]

*Iva frutescens* Linnaeus—Jesuits'-bark (Figure 29).  $2n = 34$ . Saline marshes and shores at normal high tide limit. [*I. frutescens* var. *oraria* (Bartlett) Fernald & Griscom]

*JACOBAEA VULGARIS* Gaertner—Stinking Willie (Figure 29).  $2n = 40$ . Wet pastures, roadsides. From Eurasia, northern Africa. [*SENECIO JACOBAEA* Linnaeus]

*Krigia biflora* (Walter) S.F. Blake—(Figure 29).  $2n = 10, 20$ . Fields, meadows.

*Krigia virginica* (Linnaeus) Willdenow—(Figure 29).  $2n = 10, 20$ . Dry fields, rock outcrops, sandy woods and roadsides.



*Lactuca biennis* (Moench) Fernald—Tall Blue Lettuce (Figure 29).  $2n = 34$ . Rich or damp, open woods, clearings, thickets.

*Lactuca canadensis* Linnaeus—Wild Lettuce (Figure 29).  $2n = 34$ . Thickets, woods borders, open woods, meadows, fields, clearings, roadsides. [*L. canadensis* var. *latifolia* Kuntze; *L. canadensis* var. *longifolia* (Michaux) Farwell; *L. canadensis* var. *obovata* Wiegand]

*Lactuca hirsuta* Muhlenberg ex Nuttall—(Figure 30).  $2n = 34$ . Dry, open woods, clearings. [*L. hirsuta* var. *sanguinea* (Bigelow) Fernald]

*LACTUCA SATIVA* Linnaeus—Garden Lettuce (Figure 30).  $2n = 18$ . Waste places. From Eurasia.

*LACTUCA SERRIOLA* Linnaeus—Prickly Lettuce (Figure 30).  $2n = 18$ . Waste places, roadsides. From Eurasia, northern Africa. [*L. SCARIOLA* Linnaeus – illegitimate name]

— *Lactuca* hybrid—

*Lactuca* × *morssii* B.L. Robinson (*pro species*)—(Figure 30). [*H. biennis* (Moench) Fernald × *H. canadensis* Linnaeus]

*LAPSANA COMMUNIS* Linnaeus—Nipplewort (Figure 30).  $2n = 14, 16$ . Waste places, roadsides, rich woods. From Eurasia.

*LASTHENIA CALIFORNICA* de Candolle ex Lindley subsp. *CALIFORNICA*—(Figure 30).  $2n = 16, 32, 48$ . Wool waste. From farther west. [*L. CHRYSOTOMA* (Fischer & C. A. Meyer) Greene; *BAERIA CHRYSOTOMA* Fischer & C. A. Meyer]

*LASTHENIA MINOR* (de Candolle) Ornduff—Coastal Goldfields (Figure 30).  $2n = 8$ . Wool waste. From farther west. [*BAERIA MINOR* (de Candolle) Ferris]

*LAYIA PLATYGLOSSA* (Fischer & C.A. Meyer) A. Gray—Tidy-tips (Figure 30).  $2n = 14$ . Wool waste. From farther west.

*LEONTODON HISPIDUS* Linnaeus—(Figure 30).  $2n = 14$ . Fields, roadsides. From Eurasia. [*L. HASTILIS* Linnaeus var. *HASTILIS*; *L. HASTILIS* var. *VULGARIS* W. D. J. Koch]

*LEONTODON SAXATILIS* Lamarck subsp. *SAXATILIS*—(Figure 31).  $2n = 8$ . Sandy beaches and open areas. From Eurasia. [*L. LEYSSEI* (Wallroth) G. Beck; *L. TARAXACOIDES* (Villars) Willdenow ex Méral de Vaumartois – illegitimate name]

*LEUCANTHEMELLA SEROTINA* (Linnaeus) Tzvelev—Giant Daisy (Figure 31).  $2n = 18$ . Roadsides. From Europe. [*CHRYSANTHEMUM ULIGINOSUM* Persoon]

*LEUCANTHEMUM VULGARE* Lamarck—Oxeye Daisy (Figure 31).  $2n = 18, 36, 54, 72, 90$ . Fields, clearings, waste places, roadsides. From Eurasia. [*CHRYSANTHEMUM LEUCANTHEMUM* Linnaeus var. *LEUCANTHEMUM*; *C. LEUCANTHEMUM* var. *PINNATIFIDUM* Lecoq & Lamotte]

— *Leucanthemum* hybrid—

*LEUCANTHEMUM* × *SUPERBUM* (Bergmans ex J. Ingram) Bergmans ex D.H. Kent—(Figure 31). [*L. LACUSTRE* (Brotero) Sampaio × *L. MAXIMUM* (Ramond) de Candolle]

*LIATRIS CYLINDRACEA* Michaux—(Figure 31).  $2n = 20$ . From farther west and south.

*LIATRIS PYCNOSTACHYA* Michaux var. *PYCNOSTACHYA*—(Figure 31).  $2n = ?$  Roadsides, waste places, fields, sandy, pine woods clearings. From farther west and south.

*Liatis scariosa* (Linnaeus) Willdenow var. *novae-angliae* (Lunell) Gandhi, S.M. Young & P. Somers—(Figure 31).  $2n = ?$  Dry, sandy, fields, open woods, clearings and roadsides. [*L. borealis* Nuttall ex J. McNab – misapplied]

*LIATRIS SPICATA* (Linnaeus) Willdenow var. *SPICATA*—(Figure 31).  $2n = 20$ . Roadsides, clearings, waste places. From farther south and west.

*MADIA GLOMERATA* Hooker—Mountain Tarweed (Figure 31).  $2n = 28$ . Waste places, roadsides. From farther west.

*MADIA GRACILIS* (Smith) D.D. Koch—(Figure 32).  $2n = 32, 48$ . Fields, waste places. From farther west. [*M. DISSITIFLORA* (Nuttall) Torrey & A. Gray; *M. SATIVA* Molina subsp. *DISSITIFLORA* (Nuttall) D. D. Keck]

*MADIA SATIVA* Molina—(Figure 32).  $2n = 32$ . Fields, waste places, roadsides. From farther west. [*M. SATIVA* var. *CONGESTA* Torrey & A. Gray]

*MATRICARIA CHAMOMILLA* Linnaeus—German Chamomile (Figure 32).  $2n = 18$ . Waste places, roadsides. From Eurasia, northern Africa. [*M. CHAMOMILLA* var. *CORONATA* J. Gay ex Boissier; *M. RECUTITA* Linnaeus]

*MATRICARIA DISCOIDEA* de Candolle—Pineapple-weed (Figure 32).  $2n = 18$ . Waste places, roadsides, fields. From farther west. [*M. MATRICARIOIDES* (Lessing) Porter – misapplied]

*MICROSERIS DOUGLASII* (de Candolle) Schultz-Bipontinus subsp. *DOUGLASII*—(Figure 32).  $2n = 18$ . Wool waste. From farther west.

*Mikania scandens* (Linnaeus) Willdenow—Climbing Hempweed (Figure 32).  $2n = 38$ . Wet thickets, swamps, stream banks, pond or lake margins, marshes.

*MULGEDIUM PULCHELLUM* (Pursh) G. Don—Blue Lettuce (Figure 32).  $2n = 18$ . Pond shores, fields. From farther west. [*LACTUCA PULCHELLA* (Pursh) de Candolle; *L. TATARICA* (Linnaeus) C. A. Meyer subsp. *PULCHELLA* (Pursh) Stebbins]

*MYCELIS MURALIS* (Linnaeus) Dumortier—(Figure 32).  $2n = 18$ . Roadsides, woodland margins or openings, waste places. From Eurasia, northern Africa. [*LACTUCA MURALIS* (Linnaeus) Gaertner – invalid name]

*NIPPONANTHEMUM NIPPONICUM* (Franchet ex Maximowicz) Kitamura—Montauk Daisy (Figure 32).  $2n = 18$ . Beaches. From Japan. [*CHRYSANTHEMUM NIPPONICUM* (Franchet ex Maximowicz) Sprenger]

*Oclemena acuminata* (Michaux) Greene—Mountain Aster (Figure 33).  $2n = 18$ . Woods, often acidic. [*Aster acuminatus* Michaux]

*Oclemena nemoralis* (Aiton) Greene—Bog Aster (Figure 33).  $2n = 18$ . *Sphagnum* bogs and shores. [*Aster nemoralis* Aiton]

— *Oclemena* hybrid—

*Oclemena* × *blakei* (Porter) G.L. Nesom—(Figure 33). [*O. acuminata* (Michaux) Greene × *O. nemoralis* (Aiton) Greene; *Aster blakei* (Porter) House]

*Omalotheca supina* (Linnaeus) de Candolle—Alpine Cudweed (Figure 33).  $2n = 28$ . Granitic alpine areas. [*Gnaphalium supinum* Linnaeus]

*Omalotheca sylvatica* (Linnaeus) Schultz-Bipontinus & F.W. Schultz—Heath Cudweed (Figure 33).  $2n = 56$ . Clearings, rocky slopes, woods borders. [*Gnaphalium sylvaticum* Linnaeus]

*ONOPORDUM ACANTHIUM* Linnaeus subsp. *ACANTHIUM*—Cotton Thistle (Figure 33).  $2n = 34$ . Waste places, roadsides, gravelly, sandy tidal shores. From Eurasia.

*Packera aurea* (Linnaeus) Å. Löve & D. Löve—Golden Ragwort (Figure 33).  $2n = 44$ . Swamps, low, wet woods, brooksides, springs, stream banks, meadows, moist roadsides. [*Senecio aureus* Linnaeus var. *aureus*; *S. aureus* var. *aquilonius* Fernald; *S. aureus* var. *gracilis* (Pursh) Hooker; *S. aureus* var. *intercurtus* Fernald]

*Packera obovata* (Muhlenberg ex Willdenow) W.A. Weber & Å. Löve—(Figure 33).  $2n = 44, 88, 90$ . Fields, woods, stream banks, rocky slopes, in calcareous soil. [*Senecio obovatus* Muhlenberg ex Willdenow]

*Packera paupercula* (Michaux) Å. Löve & D. Löve—Balsam Groundsel (Figure 33).  $2n = 44, 46, 92$ . Stream banks, rocky, open outcrops, slopes and woods. [*S. gaspensis* Greenman; *Senecio pauperculus* Michaux var. *pauperculus*; *S. pauperculus* var. *balsamitae* (Muhlenberg ex Willdenow) Fernald; *S. pauperculus* var. *praelongus* (Greenman) House]

*Packera schweinitziana* (Nuttall) W.A. Weber & Å. Löve—(Figure 34).  $2n = 44$ . Meadows, shores, swamps, thickets, fields, roadside ditches. [*Senecio robbinsii* Oakes ex Rusby]

*PALAFOXIA TEXANA* de Candolle—(Figure 34).  $2n = 22$ . Riverbanks. From farther south.

*PARTHENIUM HYSTEROPHORUS* Linnaeus—Santa Maria (Figure 34).  $2n = 34$ . Waste places. From Mexico, Central America, Caribbean, South America.

*PARTHENIUM INTEGRIFOLIUM* Linnaeus—Wild Quinine (Figure 34).  $2n = 72$ . Railroads, fields. From farther west and south.

*Petasites frigidus* (Linnaeus) Fries var. *palmatus* (Aiton) Cronquist—Sweet Coltsfoot (Figure 34).  $2n = 60, 61, 62$ . Swampy woods, streambanks, damp clearings, roadside ditches. [*P. palmatus* (Aiton) A. Gray]

*PETASITES HYBRIDUS* (Linnaeus) G. Gaertner, B. Meyer & Scherbius—Butterbur (Figure 34).  $2n = 60$ . Brooksides, waste places. From Eurasia.

*PICRIS HIERACIOIDES* Linnaeus—(Figure 34).  $2n = 10$ . Dry fields, roadsides, waste places. From Eurasia.

*Pityopsis falcata* (Pursh) Nuttall—(Figure 34).  $2n = 18$ . Dry, sandy, open soil, railroads. [*Chrysopsis falcata* (Pursh) Elliott]

*PLUCHEA CAMPHORATA* (Linnaeus) de Candolle—Spicy Fleabane (Figure 34).  $2n = ?$  Salt marshes. From farther south.

*Pluchea odorata* (Linnaeus) Cassini var. *succulenta* (Fernald) Cronquist—Saltmarsh Fleabane (Figure 35).  $2n = 20$ . Salt marshes, sandy shores of coastal ponds, tidal flats. [*P. purpurascens* (Swartz) de Candolle var. *succulenta* Fernald]

*Polymnia canadensis* Linnaeus—(Figure 35).  $2n = 30$ . Damp, calcareous woods.

*Prenanthes alba* Linnaeus—White Lettuce (Figure 35).  $2n = 32$ . Rich woods, thickets, mostly moist. [*Nabalus albus* (Linnaeus) Hooker]

*Prenanthes altissima* Linnaeus—(Figure 35).  $2n = 16$ . Rich, moist woods, shaded roadsides. [*Nabalus altissimus* (Linnaeus) Hooker]

*Prenanthes boottii* (de Candolle) D. Dietrich—Alpine Rattlesnake-root (Figure 35).  $2n = 32$ . Alpine areas. [*Nabalus boottii* de Candolle]

*Prenanthes racemosa* Michaux—Glaucous White Lettuce (Figure 35).  $2n = 16$ . River shores. [*Nabalus racemosus* (Michaux) Hooker]

*Prenanthes serpentaria* Pursh—Cankerweed (Figure 35).  $2n = 16$ . Dry, open woods, clearings, woodland borders. [*Nabalus serpentarius* (Pursh) Hooker]

*Prenanthes trifoliolata* (Cassini) Fernald—(Figure 35).  $2n = 16$ . Open woods, thickets, clearings. [*P. trifoliolata* var. *nana* (Bigelow) Fernald; *Nabalus trifoliolatus* Cassini]

— *Prenanthes* hybrid—

*Prenanthes* × *mainsensis* A. Gray (*pro speces*)—(Figure 35). [*P. racemosa* Michaux × *P. trifoliolata* (Cassini) Fernald]

*Pseudognaphalium macounii* (Greene) Kartesz—(Figure 36).  $2n = ?$  Dry fields, clearings, woods margins, roadsides. [*Gnaphalium macounii* Greene; *G. viscosum* Kunth – misapplied; *P. viscosum* Kunth) Anderberg – misapplied]

*Pseudognaphalium micradenum* (Weatherby) G.L. Nesom—(Figure 36).  $2n = ?$  Dry, sandy woods, thickets, clearings, roadsides. [*Gnaphalium obtusifolium* Linnaeus var. *micradenum* Weatherby]

*Pseudognaphalium obtusifolium* (Linnaeus) Hilliard & B.L. Burt—Sweet Everlasting (Figure 36).  $2n = ?$  Dry fields, woods margins, dry clearings, roadsides. [*Gnaphalium obtusifolium* Linnaeus var. *obtusifolium*; *Gnaphalium obtusifolium* Linnaeus var. *praecox* Fernald]

*RATIBIDA COLUMNIFERA* (Nuttall) Wooten & Standley—(Figure 36).  $2n = 28$ . Fields. From farther west.

*RATIBIDA PINNATA* (Ventenat) Barnhart—Grayhead Prairie-coneflower (Figure 36).  $2n = 28$ . Waste areas, roadsides. From farther west and south.

*RUDBECKIA FULGIDA* Aiton var. *SPECIOSA* (Wenderoth) Perdue—(Figure 36).  $2n = ca. 76$ . Open swamp, roadsides in moist soil. From farther west and south. [*R. SPECIOSA* Wenderoth]

*Rudbeckia hirta* Linnaeus var. *hirta*—(Figure 36).  $2n = 38$ . Open woods, fields, roadsides.

*Rudbeckia hirta* Linnaeus var. *pulcherrima* Farwell—Black-eyed Susan (Figure 36).  $2n = 38$ . Fields, meadows, clearings, roadsides. [*R. bicolor* Nuttall; *R. serotina* Nuttall var. *serotina*; *R. serotina* var. *lanceolata* (Bischoff) Fernald & B. G. Schubert; *R. serotina* var. *sericea* (T. V. Moore) Fernald & B. G. Schubert]

*Rudbeckia laciniata* Linnaeus var. *laciniata*—(Figure 36).  $2n = 36, 54$ . Swampy thickets, rich, low ground, stream banks, meadows, roadsides. [*R. laciniata* var. *hortensia* L. H. Bailey]

*RUDBECKIA SUBTOMENTOSA* Pursh—Sweet Coneflower (Figure 37).  $2n = 38$ . Roadsides. From farther west.

*RUDBECKIA TRILOBA* Linnaeus var. *TRILOBA*—Brown-eyed Susan (Figure 37).  $2n = 38, 57$ . Field, waste places, roadsides, woods, meadows, stream banks. From farther south and west.

*SANTOLINA CHAMAECYPARISSIUS* Linnaeus—Lavender-cotton (Figure 37).  $2n = 18$ . Dry, sandy banks, roadsides, thin, pine woods. From Europe.

*Sclerolepis uniflora* (Walter) Britton, Sterns, & Poggenberg—Pink Bogbutton (Figure 37).  $2n = 30$ . Sandy or sphagnum shores or shallow water of ponds and lakes.

*SCORZONEROIDES AUTUMNALIS* (Linnaeus) Moench—Fall Dandelion (Figure 37).  $2n = 12, 24$ . Fields, meadows, roadsides. From Eurasia. [*LEONTODON AUTUMNALIS* Linnaeus var. *AUTUMNALIS*; *L. AUTUMNALIS* var. *PRATENSIS* Koch]

*SENECIO EREMOPHILUS* Richardson var. *MACDOUGALII* (A. Heller) Cronquist—(Figure 37).  $2n = 40$ . From farther west. [*S. MACDOUGALII* A. Heller]

*SENECIO SYLVATICUS* Linnaeus—Heath Groundsel (Figure 37).  $2n = 40$ . Cliff crevices, sandy beaches, gravelly seashores, waste places, roadsides. From Europe.

*SENECIO VISCOSUS* Linnaeus—(Figure 37).  $2n = 40$ . Waste places. From Eurasia.

*SENECIO VULGARIS* Linnaeus—Common Groundsel (Figure 37).  $2n = 40$ . Roadsides, waste places. From Eurasia, northern Africa.

*Sericocarpus asteroides* (Linnaeus) Nees—Toothed White-top Aster (Figure 38).  $2n = 18$ . Dry woods, clearings, and fields, roadsides. [*Aster paternus* Cronquist]

*Sericocarpus limifolius* (Linnaeus) Britton, Sterns, & Poggenberg—(Figure 38).  $2n = 18$ . Dry woods, clearings, and fields, roadsides. [*Aster solidagineus* (Michaux) Nees]

*SIGESBECKIA JORULLENSIS* Kunth—(Figure 38).  $2n = 30$ . Waste places. From Mexico, Central America, South America.

*SILPHIUM PERFOLIATUM* Linnaeus var. *PERFOLIATUM*—Cup-plant (Figure 38).  $2n = 14$ . Moist thickets, low, open woods, moist roadsides, waste places. From farther west and south.

*SILYBUM MARIANUM* (Linnaeus) Gaertner—Milk Thistle (Figure 38).  $2n = 34$ . Waste places. From Eurasia, northern Africa.

*Solidago altissima* Linnaeus subsp. *altissima*—(Figure 38).  $2n = 36, 54$ . Clearings, fields, meadows, thickets, roadsides, waste places. [*S. canadensis* Linnaeus var. *scabra* (Muhlenberg ex Willdenow) Torrey & A. Gray]

*Solidago arguta* Aiton var. *arguta*—(Figure 38).  $2n = 18$ . Open woods, clearings, roadsides.

*Solidago bicolor* Linnaeus—Silverrod (Figure 38).  $2n = 18$ . Dry, open, sterile soils, open woods, rocky slopes, roadsides.

*Solidago caesia* Linnaeus var. *caesia*—Blue-stem Goldenrod (Figure 38).  $2n = 18$ . Open or rich woods, woods margins, clearings, thickets.

*Solidago canadensis* Linnaeus var. *canadensis*—(Figure 39).  $2n = 18$ . Fields, roadsides, thickets, clearings, open woods.

*Solidago canadensis* Linnaeus var. *hargeri* Fernald—(Figure 39).  $2n = 18$ . Fields, roadsides, thickets, clearings.

*Solidago flexicaulis* Linnaeus—Zig-zag Goldenrod (Figure 39).  $2n = 18, 36$ . Rich woods, thickets.

*Solidago gigantea* Aiton—(Figure 39).  $2n = 18, 36, 54$ . Damp thickets, meadows, stream banks, fields, swamps, open woods, roadsides. [*S. gigantea* var. *leiophylla* Fernald; *S. gigantea* var. *serotina* (Kuntze) Cronquist]

*Solidago hispida* Muhlenberg ex Willdenow—(Figure 39).  $2n = 18$ . Dry, open, rocky woods, usually in calcareous soil. [*S. hispida* var. *lanata* (Hooker) Fernald; *S. bicolor* Linnaeus var. *concolor* Torrey & A. Gray; *S. bicolor* var. *lanata* (Hooker) A. Gray]

*Solidago juncea* Aiton—Early Goldenrod (Figure 39).  $2n = 18$ . Fields, dry, open soil.

*Solidago latissimifolia* Miller—(Figure 39).  $2n = 18, 36, 54$ . Swamps, meadows, low thickets. [*S. elliotii* Torrey & A. Gray var. *elliottii*; *S. elliotii* var. *ascendans* Fernald]

*Solidago leiocarpa* de Candolle—Cutler's Alpine Goldenrod (Figure 39).  $2n = 36$ . Granitic alpine areas. [*S. cutleri* Fernald]

*Solidago lepida* de Candolle subsp. *fallax* (Fernald) Sempé—(Figure 39).  $2n = 18$ . Thickets, shores. [*S. lepida* var. *molina* Fernald]

*Solidago macrophylla* Banks ex Pursh—(Figure 40).  $2n = 18$ . Shaded, rocky, mountain slopes. [*S. macrophylla* var. *thyrsoides* (E. Meyer) Fernald]

*Solidago multiradiata* Aiton—Northern Mountain Goldenrod (Figure 40).  $2n = 18, 36$ . Rocky, alpine slopes.

*Solidago nemoralis* Aiton subsp. *nemoralis*—Gray Goldenrod (Figure 40).  $2n = 18, 36$ . Dry fields, open, sandy or gravelly soils, roadsides.

- Solidago odora* Aiton subsp. *odora*—Sweet Goldenrod (Figure 40).  $2n = 18$ . Dry, open woods, clearings, roadsides.
- Solidago patula* Muhlenberg ex Willdenow subsp. *patula*—Rough-leaved Goldenrod (Figure 40).  $2n = 18$ . Calcareous swamps, meadows, swales, wet woods and moist roadsides.
- Solidago ptarmicoides* (Torrey & Gray) B. Boivin—Snowy Aster (Figure 40).  $2n = 18$ . Dry, usually calcareous, ledges. [*Aster ptarmicoides* Torrey & Gray; *Oligoneuron album* (Nuttall) G.L. Nesom]
- Solidago puberula* Nuttall subsp. *puberula*—(Figure 40).  $2n = 18$ . Dry, open woods, clearings, sandy or rocky shores of ponds and streams, roadsides.
- Solidago rigida* Linnaeus subsp. *rigida*—(Figure 40).  $2n = 18, 36$ . Dry, open woods, clearings, thickets, near salt marshes, roadsides. [*Oligoneuron rigidum* (Linnaeus) Small]
- Solidago rugosa* Miller var. *rugosa*—(Figure 40).  $2n = 18, 36$ . Moist, open soil, fields, thickets, borders of woods and streams. [*S. rugosa* var. *villosa* (Pursh) Fernald]
- Solidago rugosa* Miller var. *sphagnophila* C. Graves—(Figure 41).  $2n = 18, 54$ . Swamps, meadows, wet thickets. [*S. aestivalis* E.P. Bicknell]
- Solidago rugosa* Miller subsp. *aspera* (Aiton) Cronquist—(Figure 41).  $2n = 18, 36$ . Open woods, fields, thickets, roadsides. [*S. aspera* Aiton]
- Solidago sempervirens* Linnaeus subsp. *sempervirens*—Seaside Goldenrod (Figure 41).  $2n = 18$ . Salt marshes, seashores, tidal rivers, heavily-salted roadsides.
- Solidago sempervirens* Linnaeus subsp. *mexicana* (Linnaeus) Semple—Seaside Goldenrod (Figure 41).  $2n = 18$ . Salt marshes, seashores, tidal rivers, heavily-salted roadsides.
- Solidago simplex* Kunth var. *monticola* (Porter) G.S. Ringius—(Figure 41).  $2n = 36$ . Dry, serpentine soils, rocky, granite barrens below alpine slopes. [*S. glutinosa* Nuttall var. *randii* (in part); *S. randii* (Porter) Britton (in part)]
- Solidago simplex* Kunth var. *racemosa* (Greene) G.S. Ringius—Riverbank Goldenrod (Figure 41).  $2n = 36$ . Dry, usually calcareous rocks and ledges along rivers. [*S. glutinosa* Nuttall var. *racemosa* (Greene) Cronquist; *S. racemosa* Greene; *S. randii* (Porter) Britton (in part)]
- Solidago speciosa* Nuttall var. *speciosa*—(Figure 41).  $2n = 18, 36, 54$ . Fields, open woods, thickets, roadsides.
- Solidago squarrosa* Muhlenberg—Stout Goldenrod (Figure 41).  $2n = 18$ . Dry or rocky, open woods, rocky openings, thickets, fields, roadsides.
- Solidago uliginosa* Nuttall—Bog Goldenrod (Figure 41).  $2n = 18, 36$ . Bogs, swamps, meadows, marshes, fens, shores, usually sphagnum habitats. [*S. uliginosa* var. *linoides* (Torrey & A. Gray) Fernald; *S. uliginosa* var. *terra-novae* (Torrey & A. Gray) Fernald; *S. purshii* Porter]
- Solidago ulmifolia* Muhlenberg ex Willdenow var. *ulmifolia*—(Figure 42).  $2n = 18$ . Dry, open or rocky woods, thickets, occasionally meadows.

— *Solidago* hybrids—

*Solidago altissima* Linnaeus subsp. *altissima* × *S. rugosa* Miller var. *rugosa*—(Figure 42).

*Solidago altissima* Linnaeus subsp. *altissima* × *S. sempervirens* Linnaeus subsp. *sempervirens*—(Figure 42).

*Solidago arguta* Aiton var. *arguta* × *S. bicolor* Linnaeus—(Figure 42).

*Solidago arguta* Aiton var. *arguta* × *S. juncea* Aiton—(Figure 42).

*Solidago arguta* Aiton var. *arguta* × *S. nemoralis* Aiton subsp. *nemoralis*—(Figure 42).

*Solidago arguta* Aiton var. *arguta* × *S. patula* Muhlenberg ex Willdenow subsp. *patula*—(Figure 42).

*Solidago* × *asperula* Desfontaines (*pro species*)—(Figure 42). [*S. rugosa* Miller var. *rugosa* × *S. sempervirens* Linnaeus subsp. *sempervirens*]

*Solidago bicolor* Linnaeus × *S. caesia* Linnaeus var. *caesia*—(Figure 42).

*Solidago bicolor* Linnaeus × *S. hispida* Muhlenberg ex Willdenow—(Figure 43).

*Solidago bicolor* Linnaeus × *S. nemoralis* Aiton subsp. *nemoralis*—(Figure 43).

*Solidago bicolor* Linnaeus × *S. odora* Aiton subsp. *odora*—(Figure 43).

*Solidago bicolor* Linnaeus × *S. puberula* Nuttall subsp. *puberula*—(Figure 43).

*Solidago bicolor* Linnaeus × *S. rugosa* Miller var. *rugosa*—(Figure 43).

*Solidago caesia* Linnaeus var. *caesia* × *S. flexicaulis* Linnaeus—(Figure 43).

*Solidago caesia* Linnaeus var. *caesia* × *S. juncea* Aiton—(Figure 43).

*Solidago caesia* Linnaeus var. *caesia* × *S. rugosa* Miller var. *rugosa*—(Figure 43).

*Solidago* × *callicola* (Fernald) Fernald (*pro species*)—(Figure 43). [*S. macrophylla* Banks ex Pursh × *S. ?*]

*Solidago canadensis* Linnaeus var. *canadensis* × *S. gigantea* Aiton—(Figure 44).

*Solidago canadensis* Linnaeus var. *canadensis* × *S. juncea* Aiton—(Figure 44).

*Solidago canadensis* Linnaeus var. *canadensis* × *S. rugosa* Miller var. *rugosa*—(Figure 44).

*Solidago canadensis* Linnaeus var. *hageri* Fernald × *S. rugosa* Miller var. *rugosa*—(Figure 44).

*Solidago gigantea* Aiton × *S. rugosa* Miller var. *rugosa*—(Figure 44).

*Solidago gigantea* Aiton × *S. sempervirens* Linnaeus subsp. *sempervirens*—(Figure 44).

*Solidago juncea* Aiton × *S. nemoralis* Aiton subsp. *nemoralis*—(Figure 44).



*Solidago juncea* Aiton × *S. sempervirens* Linnaeus subsp. *sempervirens*—(Figure 44).

*Solidago latissimifolia* Miller × *S. rugosa* Miller var. *sphagnophila* C. Graves—(Figure 44).

*Solidago leiocarpa* de Candolle × *S. simplex* Kunth var. *monticola* (Porter) G. S. Ringius—(Figure 45).

*Solidago macrophylla* Banks ex Pursh × *S. rugosa* Miller var. *rugosa*—(Figure 45).

*Solidago nemoralis* Aiton subsp. *nemoralis* × *S. sempervirens* Linnaeus subsp. *sempervirens*—(Figure 45).

*Solidago nemoralis* Aiton subsp. *nemoralis* × *S. speciosa* Nuttall var. *speciosa*—(Figure 45).

*Solidago odora* Aiton subsp. *odora* × *S. rugosa* Miller var. *rugosa*—(Figure 45).

*Solidago rugosa* Miller var. *rugosa* × *S. ulmifolia* Muhlenberg ex Willdenow var. *ulmifolia*—(Figure 45).

*SONCHUS ARVENSIS* Linnaeus subsp. *ARVENSIS*—Corn Sow-thistle (Figure 45).  $2n = 54$ . Waste places, fields, roadsides, shores, usually wet sites. From Eurasia, northern Africa.

*SONCHUS ARVENSIS* Linnaeus subsp. *ULIGINOSUS* (M. Bieberstein) Nyman—(Figure 45).  $2n = 36$ . Waste places, fields, roadsides, shores, usually wet sites. From Eurasia. [*S. ARVENSIS* var. *GLABRESCENS* Günther, Grabowski, & Wimmer; *S. ULIGINOSUS* M. Bieberstein]

*SONCHUS ASPER* (Linnaeus) Hill—Prickly Sow-thistle (Figure 45).  $2n = 18$ . Waste places, roadsides, sea shores. From Eurasia, northern Africa.

*SONCHUS OLERACEUS* Linnaeus—Common Sow-thistle (Figure 46).  $2n = 32, 36$ . Waste places, fields, roadsides, sea shores. From Eurasia, northern Africa.

*Symphyotrichum anticostense* (Fernald) G.L. Nesom—(Figure 46).  $2n = 80$ . Gravelly, river shores. [*Aster anticostensis* Fernald]

*Symphyotrichum boreale* (Torrey & A. Gray) Å. Löve & D. Löve—Northern Bog Aster (Figure 46).  $2n = 16, 32, 48, 64$ . Bogs, swamps, shores, mostly in calcareous areas. [*Aster borealis* (Torrey & A. Gray) Provancher; *A. junctiformis* Rydberg]

*SYMPHYOTRICHUM CILIATUM* (Ledebour) G.L. Nesom—Rayless Aster (Figure 46).  $2n = 14$ . Roadsides, waste places. From farther west. [*ASTER BRACHYACTIS* S. F. Blake]

*Symphyotrichum ciliolatum* (Lindley) Å. Löve & D. Löve—(Figure 46).  $2n = 48$ . Dry woods, thickets, shores, clearings, roadsides. [*Aster ciliolatus* Lindley]

*Symphyotrichum concolor* (Linnaeus) G.L. Nesom var. *concolor*—Eastern Silvery Aster (Figure 46).  $2n = 8$ . Dry, open, sandy woods, fields and barrens, roadsides. [*Aster concolor* Linnaeus]

*Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom—Common Blue Wood Aster (Figure 46).  $2n = 16, 32$ . Thickets, open woods, clearings, fields, roadsides, often in moist soil. [*Aster cordifolius* Linnaeus var. *cordifolius*; *A. cordifolius* var. *furibishiae* Fernald; *A. cordifolius* var. *polycephalus* Porter; *A. cordifolius* var. *racemiflorus* Fernald; *A. lowrieanus* Porter var.

*lowrieanus*; *A. lowrieanus* var. *lanceolatus* (Porter) Porter; *A. sagittifolius* Wedemeyer ex Willdenow]

*Symphytotrichum dumosum* (Linnaeus) G.L. Nesom—Rice-button Aster (Figure 46).  $2n = 16, 32$ . Dry, open woods, fields, thickets, roadsides. [*Aster dumosus* Linnaeus var. *dumosus*; *A. dumosus* var. *cordifolius* (Michaux) Torrey & A. Gray; *A. dumosus* var. *strictior* Torrey & A. Gray; *A. dumosus* var. *subulfolius* Torrey & A. Gray]

*Symphytotrichum ericoides* (Linnaeus) G.L. Nesom var. *ericoides*—White Heath Aster (Figure 46).  $2n = 10, 20$ . Dry fields and clearings, dry, open woods, waste places, roadsides, sometimes in moist, open, sandy sites. [*Aster ericoides* Linnaeus]

*SYMPHYOTRICHUM FRONDOSUM* (Nuttall) G.L. Nesom—(Figure 47).  $2n = 14$ . Wool waste. From farther west. [*Aster frondosus* (Nuttall) Torrey & A. Gray]

*Symphytotrichum laeve* (Linnaeus) Å. Löve & D. Löve var. *laeve*—Smooth Aster (Figure 47).  $2n = 48$ . Dry fields, open woods, roadsides, dry, open, sites. [*Aster laevis* Linnaeus]

*Symphytotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum*—Panicled Aster (Figure 47).  $2n = 32, 40, 48, 56, 64$ . Meadows, wet thickets, shores. [*Aster lanceolatus* Willdenow var. *lanceolatus*; *A. lanceolatus* var. *simplex* (Willdenow) A. G. Jones; *A. simplex* Willdenow var. *simplex*; *A. simplex* var. *ramosissimus* (Torrey & A. Gray) Cronquist]

*Symphytotrichum lanceolatum* (Willdenow) G.L. Nesom var. *interior* (Wiegand) G. L. Nesom—(Figure 47).  $2n = 48, 64$ . Gravelly or rocky shores, often calcareous. [*Aster lanceolatus* Willdenow var. *interior* Semple & Chmielewski; *A. simplex* Willdenow var. *interior* (Wiegand) Cronquist]

*Symphytotrichum lanceolatum* (Willdenow) G.L. Nesom var. *latifolium* (Semple & Chmielewski) G.L. Nesom—(Figure 47).  $2n = 64$ . Thickets, woods margins, shores.

*Symphytotrichum lateriflorum* (Linnaeus) Å. Löve & D. Löve—Calico Aster (Figure 47).  $2n = 16, 32, 48$ . Woods, swamps, fields, thickets, clearings, shores, meadows, moist ledges, roadsides. [*Aster lateriflorus* (Linnaeus) Britton; *A. lateriflorus* var. *angustifolius* Wiegand; *A. lateriflorus* var. *pendulus* (Aiton) E. S. Burgess; *A. lateriflorus* var. *tenuipes* Wiegand; *A. vimineus* Lamarck]

*Symphytotrichum novae-angliae* (Linnaeus) G.L. Nesom—New England Aster (Figure 47).  $2n = 10$ . Fields, damp thickets, shores, meadows, clearings, open woods, roadsides. [*Aster novae-angliae* Linnaeus]

*Symphytotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii*—New York Aster (Figure 47).  $2n = 48$ . Swamps, salt marshes, damp thickets, shores, sea beaches, moist woods, meadows, roadsides. [*Aster foliaceus* Lindley ex de Candolle – misapplied; *A. foliaceus* var. *arcuatus* Fernald; *A. johannensis* Fernald var. *johannensis*; *A. longifolius* Lamarck; *A. novi-belgii* Linnaeus var. *novi-belgii*]

*Symphytotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *elodes* (Torrey & A. Gray) G.L. Nesom—(Figure 47).  $2n = 48$ . Salt marshes, pine barrens. [*Aster novi-belgii* Linnaeus var. *elodes* (Torrey & A. Gray) A. Gray]

- Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *villicaule* (A. Gray) Labrecque & Brouillet—(Figure 48).  $2n = 48$ . Gravelly or rocky, river shores, ledges. [*Aster johannensis* Fernald var. *villicaulis* (A. Gray) Fernald]
- Symphyotrichum ontarionis* (Wiegand) G.L. Nesom var. *ontarionis*—(Figure 48).  $2n = 32$ . Thickets, meadows, alluvial woods and shores, often in calcareous soil. [*Aster ontarionis* Wiegand]
- Symphyotrichum patens* (Aiton) G.L. Nesom var. *patens*—Late Purple Aster (Figure 48).  $2n = 10, 20$ . Dry fields, open woods, clearings and roadsides. [*Aster patens* Aiton var. *patens*]
- Symphyotrichum pilosum* (Willdenow) G.L. Nesom var. *pilosum*—Frost Aster (Figure 48).  $2n = 32, 40, 48$ . Dry fields, thickets, open woods, clearings and roadsides, often in sandy soil. [*Aster pilosus* Willdenow var. *pilosus*]
- Symphyotrichum pilosum* (Willdenow) G.L. Nesom var. *pringlei* (A. Gray) G.L. Nesom—(Figure 48).  $2n = 48$ . Rocky, gravelly or sandy soil, often calcareous. [*Aster pilosus* Willdenow var. *demotus* S. F. Blake; *A. pilosus* var. *pringlei* S. F. Blake]
- Symphyotrichum praealtum* (Poirot) G.L. Nesom—Willow Aster (Figure 48).  $2n = 32, 48, 64$ . Low thickets and woods, meadows. [*Aster praealtus* Poirot var. *praealtus*; *A. praealtus* var. *angustior* Wiegand]
- Symphyotrichum prenanthoides* (Muhlenberg ex Willdenow) G.L. Nesom—Zigzag Aster (Figure 48).  $2n = 32$ . Moist thickets and fields, rich woods, shores, roadsides. [*Aster prenanthoides* Muhlenberg ex Willdenow]
- Symphyotrichum puniceum* (Linnaeus) Å. Löve & D. Löve var. *puniceum*—Swamp Aster (Figure 48).  $2n = 16, 32$ . Low thickets, woods, swamps, meadows, shores, ditches, roadsides. [*S. firmum* (Nees) G.L. Nesom; *Aster puniceus* Linnaeus var. *puniceus*; *A. puniceus* var. *compactus* Fernald; *A. puniceus* var. *firmus* (Nees) Torrey & A. Gray; *A. puniceus* var. *oligocephalus* Fernald; *A. puniceus* var. *perlongus* Fernald]
- Symphyotrichum racemosum* (Elliott) G.L. Nesom—Small White Aster (Figure 48).  $2n = 16$ . Fields, meadows, shores, woods, clearings, roadsides. [*Aster vimineus* Lamarck – misapplied; *A. vimineus* var. *subdumosus* Wiegand]
- Symphyotrichum subulatum* (Michaux) G.L. Nesom var. *subulatum*—Annual Saltmarsh Aster (Figure 49).  $2n = 10$ . Salt marshes, salted highways. [*Aster subulatus* Michaux var. *subulatus*; *A. subulatus* var. *eurocauster* Fernald & Griscom]
- Symphyotrichum tenuifolium* (Linnaeus) G.L. Nesom var. *tenuifolium*—Perennial Saltmarsh Aster (Figure 49).  $2n = 10$ . Salt marshes, tidal shores. [*Aster tenuifolius* Linnaeus]
- Symphyotrichum tradescantii* (Linnaeus) G.L. Nesom—Shore Aster (Figure 49).  $2n = 16, 32$ . Rocky or gravelly, freshwater shores, waste places. [*Aster tradescantii* Linnaeus]
- Symphyotrichum undulatum* (Linnaeus) G.L. Nesom—(Figure 49).  $2n = 16, 32$ . Dry fields and open, deciduous woods, clearings, fields, roadsides. [*Aster undulatus* Linnaeus; *A. undulatus* var. *loriformis* E. S. Burgess]
- Symphyotrichum urophyllum* (Lindley ex de Candolle) G.L. Nesom—(Figure 49).  $2n = 16$ . Dry open, woods, clearings and fields. [*Aster sagittifolius* Wedemeyer ex Willdenow – misapplied]

— *Symphyotrichum* hybrids —

- Symphyotrichum* × *amethystinum* (Nuttall) G.L. Nesom (*pro species*)—(Figure 49). [*S. ericoides* (Linnaeus) G.L. Nesom var. *ericoides* × *S. novae-angliae* (Linnaeus) G.L. Nesom; *Aster* × *amethystinus* Nuttall (*pro species*)]
- Symphyotrichum ciliolatum* (Lindley) Á. Löve & D. Löve × *S. prenanthoides* (Muhlenberg ex Willdenow) G.L. Nesom—(Figure 49).
- Symphyotrichum ciliolatum* (Lindley) Á. Löve & D. Löve × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 49).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. ericoides* (Linnaeus) G.L. Nesom var. *ericoides*—(Figure 49).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. lateriflorum* (Linnaeus) Á. Löve & D. Löve—(Figure 50).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii*—(Figure 50).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. pilosum* (Willdenow) G.L. Nesom var. *pringlei* (A. Gray) G.L. Nesom —(Figure 50).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 50).
- Symphyotrichum cordifolium* (Linnaeus) G.L. Nesom × *S. undulatum* (Linnaeus) G.L. Nesom—(Figure 50).
- Symphyotrichum dumosum* (Linnaeus) G.L. Nesom × *S. lateriflorum* (Linnaeus) Á. Löve & D. Löve—(Figure 50).
- Symphyotrichum dumosum* (Linnaeus) G.L. Nesom × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 50).
- Symphyotrichum dumosum* (Linnaeus) G.L. Nesom × *S. racemosum* (Elliott) G.L. Nesom—(Figure 50).
- Symphyotrichum dumosum* (Linnaeus) G.L. Nesom × *S. tradescantii* (Linnaeus) G.L. Nesom—(Figure 50).
- Symphyotrichum ericoides* (Linnaeus) G.L. Nesom var. *ericoides* × *S. novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii*—(Figure 51).
- Symphyotrichum ericoides* (Linnaeus) G.L. Nesom var. *ericoides* × *S. undulatum* (Linnaeus) G.L. Nesom—(Figure 51).
- Symphyotrichum laeve* (Linnaeus) Á. Löve & D. Löve var. *laeve* × *S. lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum*—(Figure 51).

- Symphyotrichum laeve* (Linnaeus) Á. Löve & D. Löve var. *laeve* × *S. praealtum* (Poirot) G.L. Nesom—(Figure 51). [*S. novi-belgii* (Linnaeus) G.L. Nesom var. *litoreum* (A. Gray) G.L. Nesom; *Aster novi-belgii* Linnaeus var. *litoreus* A. Gray; however, the parentage for this hybrid is in doubt]
- Symphyotrichum laeve* (Linnaeus) Á. Löve & D. Löve var. *laeve* × *S. racemosum* (Elliott) G.L. Nesom—(Figure 51).
- Symphyotrichum laeve* (Linnaeus) Á. Löve & D. Löve var. *laeve* × *S. undulatum* (Linnaeus) G.L. Nesom—(Figure 51).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. novae-angliae* (Linnaeus) G.L. Nesom—(Figure 51).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii*—(Figure 51).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. pilosum* (Willdenow) G.L. Nesom var. *pringlei* (A. Gray) G.L. Nesom—(Figure 51).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. praealtum* (Poirot) G.L. Nesom—(Figure 52).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 52).
- Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom var. *lanceolatum* × *S. tradescantii* (Linnaeus) G.L. Nesom—(Figure 52).
- Symphyotrichum lateriflorum* (Linnaeus) Á. Löve & D. Löve × *S. novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii*—(Figure 52).
- Symphyotrichum lateriflorum* (Linnaeus) Á. Löve & D. Löve × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 52).
- Symphyotrichum lateriflorum* (Linnaeus) Á. Löve & D. Löve × *S. racemosum* (Elliott) G.L. Nesom—(Figure 52).
- Symphyotrichum lateriflorum* (Linnaeus) Á. Löve & D. Löve × *S. undulatum* (Linnaeus) G.L. Nesom—(Figure 52).
- Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii* × *S. pilosum* (Willdenow) G.L. Nesom var. *pringlei* (A. Gray) G.L. Nesom—(Figure 52).
- Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii* × *S. praealtum* (Poirot) G.L. Nesom—(Figure 52).
- Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii* × *S. prenanthoides* (Muhlenberg ex Willdenow) G.L. Nesom—(Figure 53).
- Symphyotrichum novi-belgii* (Linnaeus) G.L. Nesom var. *novi-belgii* × *S. puniceum* (Linnaeus) Á. Löve & D. Löve var. *puniceum*—(Figure 53).

*Symphyotrichum pilosum* (Willdenow) G.L. Nesom var. *pilosum* × *S. undulatum* (Linnaeus) G.L. Nesom—(Figure 53).

*Symphyotrichum* × *tardiflorum* (Linnaeus) Greuter, Aghababian & Wagenitz—(Figure 53). [*S. cordifolium* (Linnaeus) G.L. Nesom × *S. puniceum* (Linnaeus) A. Löve & D. Löve var. *puniceum*; *Aster tardiflorus* Linnaeus]

*TAGETES ERECTA* Linnaeus—African Marigold (Figure 53).  $2n = 24, 48$ . Waste places. From Mexico, Central and South America. [*T. PATULA* Linnaeus; *T. SIGNATA* Bartling; *T. TENUIFOLIA* Cavanilles]

*TAGETES MINUTA* Linnaeus—Southern Marigold (Figure 53).  $2n = 48$ . Waste places, fields. From South America.

*TANACETUM BALSAMITA* Linnaeus—Costmary (Figure 53).  $2n = 54$ . Roadsides. From Asia. [*CHRYSANTHEMUM BALSAMITA* (Linnaeus) Baillon]

*Tanacetum bipinnatum* (Linnaeus) Schultz-Bipontinus—(Figure 53).  $2n = 18, 54$ . Gravelly or sandy riverbanks. [*T. huronense* Nuttall var. *huronense*; *T. huronense* Nuttall var. *johannense* Fernald]

*TANACETUM PARTHENIUM* (Linnaeus) Schultz-Bipontinus—Feverfew (Figure 53).  $2n = 18$ . Roadsides, waste places. From Europe. [*CHRYSANTHEMUM PARTHENIUM* (Linnaeus) Bernhardt]

*TANACETUM VULGARE* Linnaeus—Common Tansy (Figure 54).  $2n = 18$ . Roadsides, field borders, waste places. From Eurasia.

*TARAXACUM ERYTHROSPERMUM* Andrzejowski ex Besser—Red-seeded Dandelion (Figure 54).  $2n = 16, 24, 32$  (Europe). Dry fields, woods, ledges, roadsides, and waste places. From Eurasia. [*T. LAEVIGATUM* (Willdenow) de Candolle – misapplied]

*Taraxacum latilobum* de Candolle—(Figure 54).  $2n = ?$  Rich slopes and talus, often calcareous.

*TARAXACUM OFFICINALE* F.H. Wiggers—Common Dandelion (Figure 54).  $2n = 16, 24, 26, 32, 40$ . Fields, meadows, roadsides, waste places. From Europe.

*TARAXACUM PALUSTRE* (Lyons) Symons—(Figure 54).  $2n = 24, 32, 40$  (European complex). Wet ditches, roadsides, fields and waste places. From Europe. [*T. OFFICINALE* F. H. Wiggers var. *PALUSTRE* Blytt – misapplied]

*THYMOPHYLLA TENUILOBA* (de Candolle) Small var. *TENUILOBA*—Dahlberg Daisy (Figure 54).  $2n = 16, 24, 32, 40$ . From Texas, Mexico. [*DYSSODIA TENUILOBA* (de Candolle) B. L. Robinson]

*TRAGOPOGON DUBIUS* Scopoli—Yellow Salsify (Figure 54).  $2n = 12$ . Fields, roadsides, waste places. From Eurasia. [*T. MAJOR* Jacquin]

*TRAGOPOGON PORRIFOLIUS* Linnaeus—Salsify (Figure 54).  $2n = 12$ . Fields, roadsides. From Eurasia, northern Africa.

*TRAGOPOGON PRATENSIS* Linnaeus—Goat's-beard (Figure 54).  $2n = 12$ . Fields, meadows, roadsides. From Eurasia.

*TRIPLEUROSPERMUM INODORUM* (Linnaeus) Schultz-Bipontinus—Scentless Chamomile (Figure 55).  $2n = 18, 36$ . Fields, roadsides, waste places. From Eurasia. [*T. MARITIMUM* (Linnaeus) W. D. J. Koch subsp. *INODORUM* (Linnaeus) Applequist; *MATRICARIA MARITIMA* Linnaeus var. *AGRESTIS* (Knaf) Wilmott; *M. PERFORATA* M érat]

*TRIPLEUROSPERMUM MARITIMUM* (Linnaeus) W.D. J. Koch subsp. *MARITIMUM*—Sea Mayweed (Figure 55).  $2n = 18, 36$ . Waste places and roadsides near the coast. From Europe. [*MATRICARIA MARITIMA* Linnaeus var. *MARITIMA*]

*TUSSILAGO FARFARA* Linnaeus—Coltsfoot (Figure 55).  $2n = 60$ . Brookside, moist banks, railroads, waste places, roadsides, trail edges. From Eurasia, northern Africa.

*Verbesina alternifolia* (Linnaeus) Britton ex Kearney—Wingstem (Figure 55).  $2n = 68$ . Woods borders, thickets, along streams, in rich soil. [*Actinomeris alternifolia* (Linnaeus) de Candolle]

*VERBESINA ENCELIOIDES* (Cavanilles) Benth & Hooker f. ex A. Gray—Golden Crownbeard (Figure 55).  $2n = 34$ . Wool waste. From farther west. [*V. ENCELIOIDES* var. *EXAURICULATA* B. L. Robinson & Greenman]

*VERNONIA FASCICULATA* Michaux—Western Ironweed (Figure 55).  $2n = 34$ . Sandy fields, wool waste. From farther west.

*VERNONIA MISSURICA* Rafinesque—(Figure 55).  $2n = 34$ . Sandy fields, wool waste. From farther south and west.

*Vernonia noveboracensis* (Linnaeus) Michaux—(Figure 55).  $2n = 34$ . Meadows, marshes, along streams, roadside ditches, swamps, wet pastures.

— *Vernonia* hybrid—

*VERNONIA* × *PERALTA* Daniels—(Figure 55). [*V. BALDWINII* Torrey × *V. MISSURICA* Rafinesque]

*XANTHISMA GRACILE* (Nuttall) D.R. Morgan & R.L. Hartman—(Figure 56).  $2n = 4, 6, 8$ . Wool waste. From farther west. [*HAPLOPAPPUS GRACILIS* (Nuttall) A. Gray]

*XANTHIUM SPINOSUM* Linnaeus—Spiny Cocklebur (Figure 56).  $2n = 36$ . Waste places. Possibly from South America. [*X. AMBROSIOIDES* Hooker & Arnott]

*Xanthium strumarium* Linnaeus—Common Cocklebur (Figure 56).  $2n = 36$ . Shores, salt marshes, waste places. [*X. chinense* Miller; *X. curvscens* Millspaugh & Sherff; *X. echinatum* Murray; *X. italicum* Moretti; *X. oligacanthum* Piper; *X. orientale* Linnaeus; *X. oviforme* Wallroth; *X. pennsylvanicum* Wallroth; *X. speciosum* Kearney; *X. wootonii* Cockerell]

*XEROCHRYSUM BRACTEATUM* (Ventenat) Tzvelev—Golden Everlasting (Figure 56).  $2n = 24, 26, 28$ . Waste places. From Australia. [*HELICHRYSUM BRACTEATUM* (Ventenat) Andrews]

*ZINNIA ELEGANS* Jacquin—Garden Zinnia (Figure 56).  $2n = 24$ . Waste places. From Mexico. [*VIOLACEA* Cavanilles]

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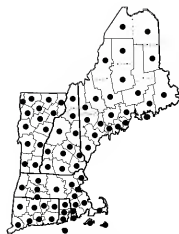
Figure 1 Key map for counties of the New England states (and Mt Desert Island, Maine; Block Island, Rhode Island; arbitrary divisions of larger Maine counties and of Coos County, New Hampshire).



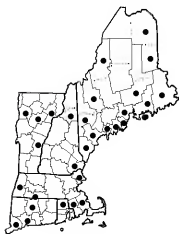
*ACHILLEA FILIPENDULINA*



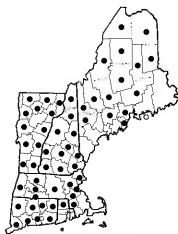
*ACHILLEA LIGUSTICA*



*Achillea millefolium*



*ACHILLEA PTARMICA*



*Ageratina alnissima*  
var. *alnissima*



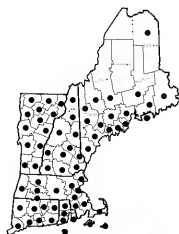
*Ageratina aromatica*



*AGERATUM CONYZOIDES*



*AGERATUM HOUSTONIANUM*



*Ambrosia artemisiifolia*

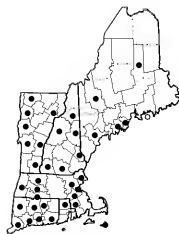
Figure 2 Distribution maps



*Ambrosia bidentata*



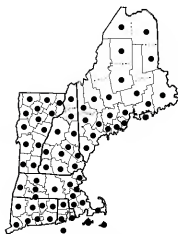
*AMBROSIA PSILOSTACHYA*



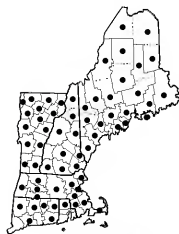
*Ambrosia trifida*



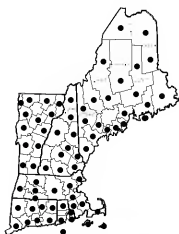
*Ambrosia x helenae*



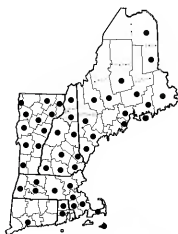
*Anaphalis margaritacea*



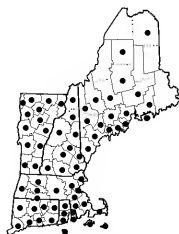
*Antennaria howellii*  
subsp. *canadensis*



*Antennaria howellii*  
subsp. *neodioica*

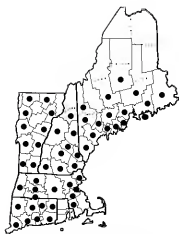


*Antennaria howellii*  
subsp. *petaloidea*

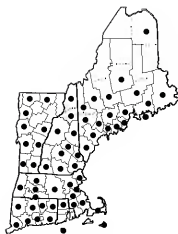


*Antennaria neglecta*

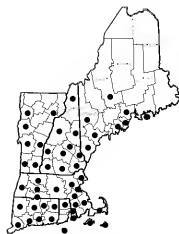
Figure 3 Distribution maps



*Antennaria perlini*  
subsp. *parlinii*



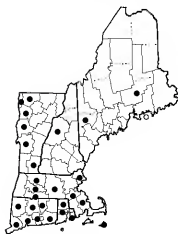
*Antennaria perlini*  
subsp. *fallax*



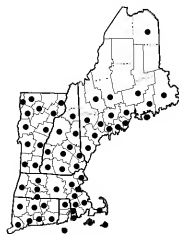
*Antennaria plantaginifolia*



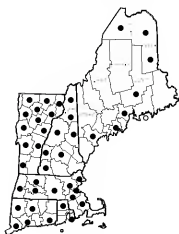
*Antennaria howellii* subsp. *petaloidea*  
X *A. plantaginifolia*



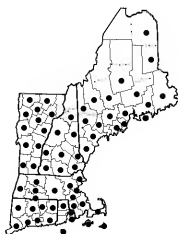
*ANTHEMIS ARVENSIS*



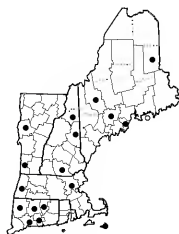
*ANTHEMIS COTULA*



*ARCTIUM LAPPA*



*ARCTIUM MINUS*



*ARCTIUM TOMENTOSUM*

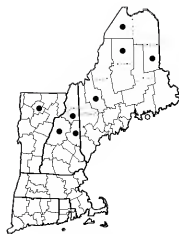
Figure 4 Distribution maps



*ARCTIUM LAPPA*  
*X A. TOMENTOSUM*



*ARCTOTIS STOECHADIFOLIA*



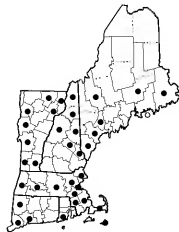
*Arnica lanceolata*  
subsp. *lanceolata*



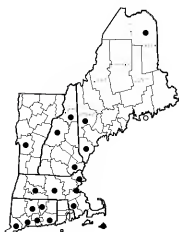
*ARNOSERIS MINIMA*



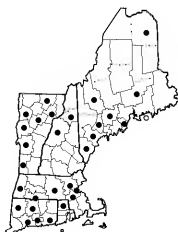
*ARTEMISIA ABROTANUM*



*ARTEMISIA ABSINTHIUM*



*ARTEMISIA ANNUA*

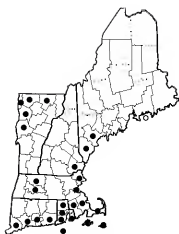


*ARTEMISIA BIENNIS*



*Artemisia campestris*  
subsp. *canadensis*

Figure 5 Distribution maps



*Artemisia campestris*  
subsp. *caudata*



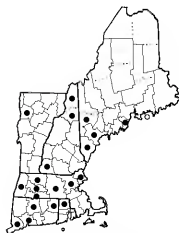
*ARTEMISIA CARRUTHII*



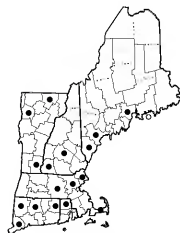
*ARTEMISIA FILIFOLIA*



*ARTEMISIA FRIGIDA*



*ARTEMISIA LUDOVICIANA*  
subsp. *LUDOVICIANA*



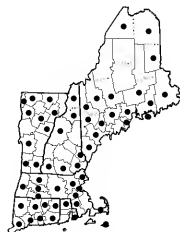
*ARTEMISIA PONTICA*



*ARTEMISIA STELLERIANA*



*ARTEMISIA TRIDENTATA*  
subsp. *TRIDENTATA*



*ARTEMISIA VULGARIS*

Figure 6 Distribution maps.



*ASTER TATARICUS*



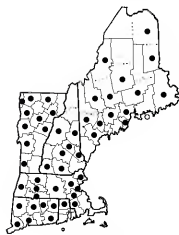
*Baccharis halimifolia*



*BELLIS PERENNIS*



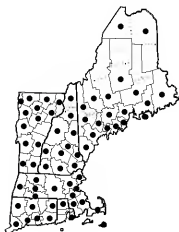
*BIDENS ARISTOSA*



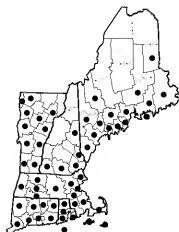
*Bidens beckii*



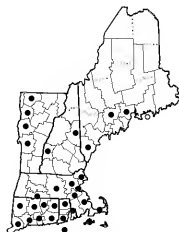
*Bidens bipinnata*



*Bidens cernua*



*Bidens comata*



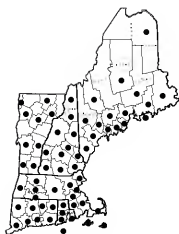
*Bidens discordea*

Figure 7 Distribution maps





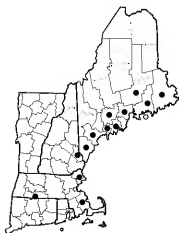
*Bidens eatonii*



*Bidens frondosa*



*Bidens heterodoxa*



*Bidens hyperborea*



*Bidens laevis*



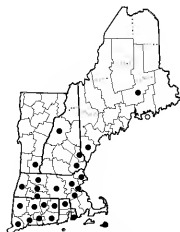
*BIDENS PILOSA*



*BIDENS TENUISECTA*

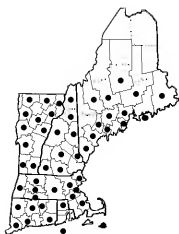


*Bidens trichosperma*



*Bidens tripartita*

Figure 8 Distribution maps



*Bidens vulgata*



*Bidens cernua*  
*X B. connata*



*Bidens cernua*  
*X B. hyerborea*



*Bidens connata*  
*X B. tripartita*



*Bidens X multiceps*



*BOLTONIA ASTEROIDES*  
var. *LATISQUAMA*



*BOLTONIA ASTEROIDES*  
var. *RECOGNITA*



*CALENDULA OFFICINALIS*



*CALLISTEPHUS CHINENSIS*

Figure 9 Distribution maps



*CALOTIS CUNEIFOLIA*



*CARDUUS ACANTHOIDES*  
subsp. *ACANTHOIDES*



*CARDUUS CRISPUS*



*CARDUUS NUTANS*



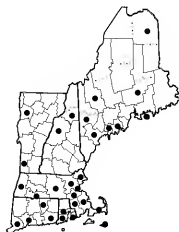
*CARTHAMUS TINCTORIUS*



*CENTAUREA BENEDICTA*



*CENTAUREA CALCITRAPA*

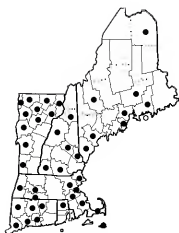


*CENTAUREA CYANUS*



*CENTAUREA DIFFUSA*

Figure 10 Distribution maps



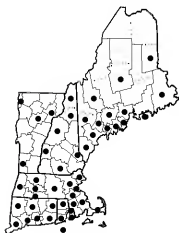
*CENTAUREA JACEA*



*CENTAUREA MELITENSIS*



*CENTAUREA MONTANA*



*CENTAUREA NIGRA*



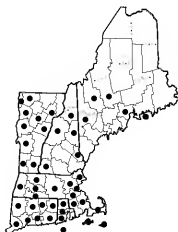
*CENTAUREA NIGRESCENS*



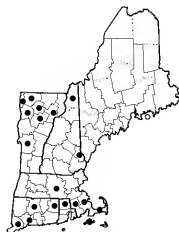
*CENTAUREA SCABIOSA*



*CENTAUREA SOLSTITIALIS*



*CENTAUREA STOEBE*  
subsp. *MICRANTHOS*



*CENTAUREA* x *MONCKTONII*

Figure 11 | Distribution maps



*CHAENACTIS GLABRIUSCULA*  
var. *GLABRIUSCULA*



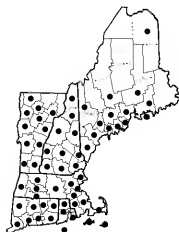
*CHAMAEMELUM NOBILE*



*Chrysopsis mariana*



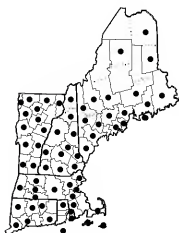
*CICHORIUM ENDIVIA*



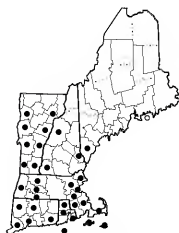
*CICHORIUM INTYBUS*



*Cirsium altissimum*



*CIRSIIUM ARVENSE*

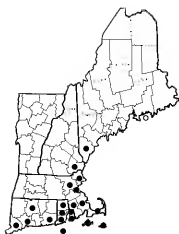


*Cirsium discolor*

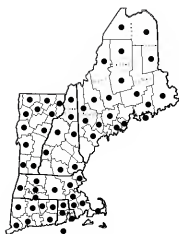


*CIRSIIUM FLODMANII*

Figure 12. Distribution maps



*Cirsium horridulum*  
var. *horridulum*



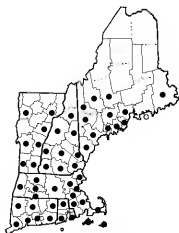
*Cirsium muticum*



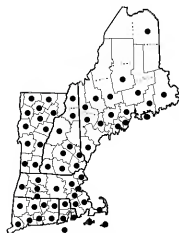
*CIRSIMUM OCHROCENTRUM*  
var. *OCHROCENTRUM*



*CIRSIMUM PALUSTRE*



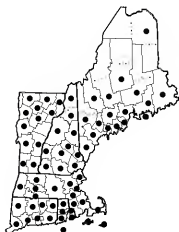
*Cirsium pumilum*  
var. *pumilum*



*CIRSIMUM VULGARE*



*CONYZA BONARIENSIS*

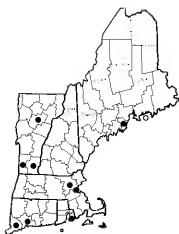


*Conyza canadensis*



*COREOPSIS BASALIS*

Figure 13 Distribution maps



*COREOPSIS GRANDIFLORA*



*COREOPSIS LANCEOLATA*



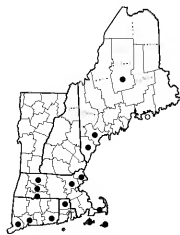
*COREOPSIS MAJOR*



*COREOPSIS PUBESCENS*



*Coreopsis rosea*



*COREOPSIS TINCTORIA*



*COREOPSIS TRIPTERIS*

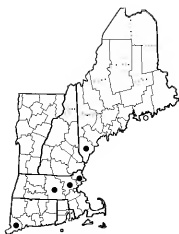


*COREOPSIS VERTICILLATA*



*COSMOS BIPINNATUS*

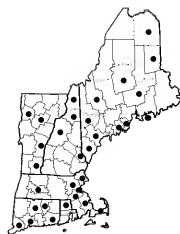
Figure 14 Distribution maps



*COSMOS PARVIFLORUS*



*COSMOS SULPHUREUS*



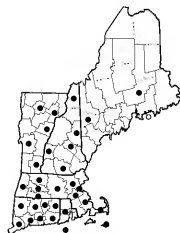
*COTA TINCTORIA*



*COTULA CORONOPIFOLIA*



*CREPIS BIENNIS*



*CREPIS CAPILLARIS*



*CREPIS FOETIDA*



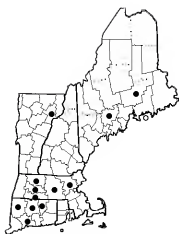
*CREPIS NICAENSIS*



*CREPIS SETOSA*

Figure 15 Distribution maps

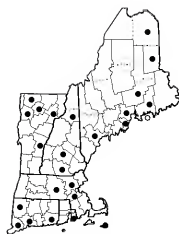




*CREPIS TECTORUM*



*CREPIS VESICARIA*



*CYCLACHAENA XANTHIIFOLIA*



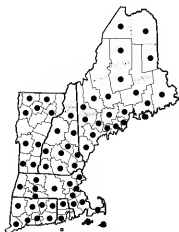
*DEINANDRA FASCICULATA*



*DITTRICHIA GRAVEOLENS*



*Doellingeria infirma*



*Doellingeria umbellata*  
var. *umbellata*



*DORONICUM PARDALIANCHES*



*DYSSODIA PAPPOSA*

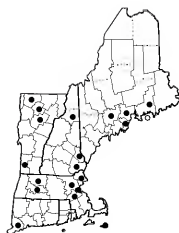
Figure 16 Distribution maps



*ECHINACEA PALLIDA*



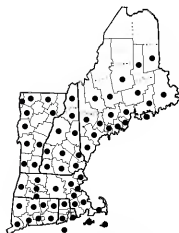
*ECHINACEA PURPUREA*



*ECHINOPS SPHAEROCEPHALUS*



*ECLIPTA PROSTRATA*



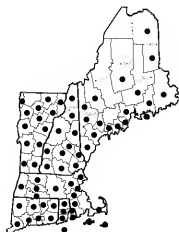
*Erechthites hieracifolius*  
var. *hieracifolius*



*Erechthites hieracifolius*  
var. *megalocarpus*



*Erigeron acris*  
var. *kantschaticus*

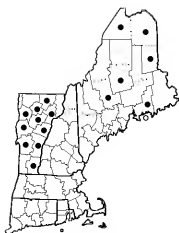


*Erigeron annuus*

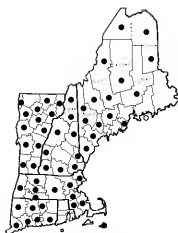


*ERIGERON GLABELLUS*  
var. *PUBESCENS*

Figure 17 Distribution maps



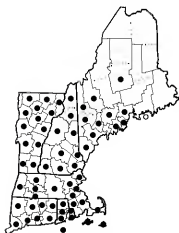
*Erigeron hyssopifolius*



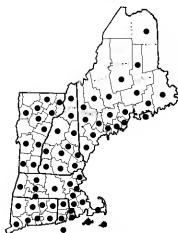
*Erigeron philadelphicus*  
var. *philadelphicus*



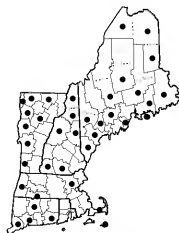
*Erigeron philadelphicus*  
var. *provancheri*



*Erigeron pulchellus*  
var. *pulchellus*



*Erigeron strigosus*  
var. *strigosus*



*Erigeron strigosus*  
var. *septentrionalis*



*Eupatorium album*  
var. *album*



*EUPATORIUM ALTISSIMUM*

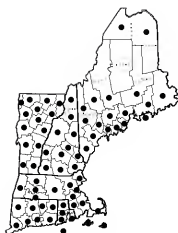


*Eupatorium hyssopifolium*  
var. *hyssopifolium*

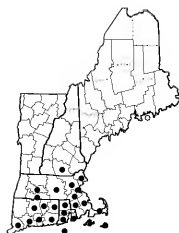
Figure 18 Distribution maps



*Eupatorium hyssopifolium*  
var. *laciniatum*



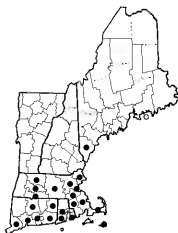
*Eupatorium perfoliatum*



*Eupatorium pilosum*



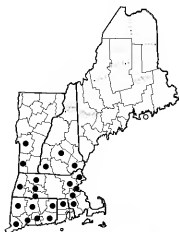
*Eupatorium rotundifolium*  
var. *rotundifolium*



*Eupatorium rotundifolium*  
var. *ovatum*



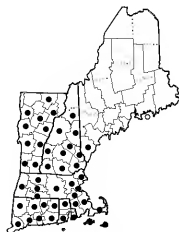
*EUPATORIUM SEROTINUM*



*Eupatorium sessilifolium*

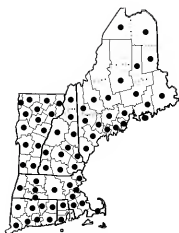


*Eupatorium X novae-angliae*



*Eurybia divaricata*

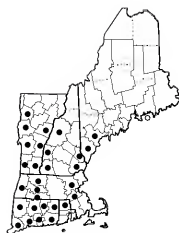
Figure 19 Distribution maps



*Eurybia macrophylla*



*Eurybia radula*



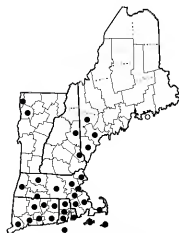
*Eurybia schreberi*



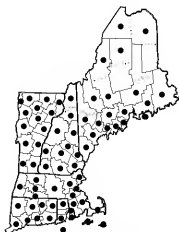
*Eurybia spectabilis*



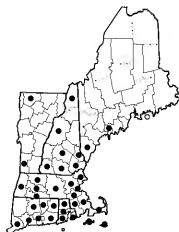
*Eurybia X herveyi*



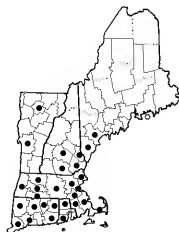
*Euthamia caroliniana*



*Euthamia graminifolia*

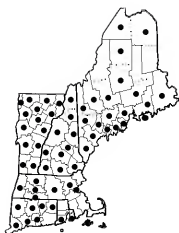


*Eutrochium dubium*

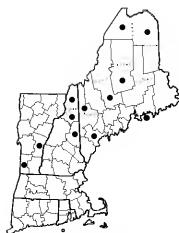


*Eutrochium fistulosum*

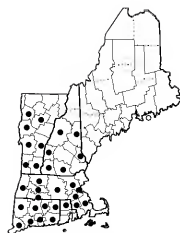
Figure 20 Distribution maps



*Eutrochium maculatum*  
var. *maculatum*



*Eutrochium maculatum*  
var. *foliosum*



*Eutrochium purpureum*  
var. *purpureum*



*FILAGO VULGARIS*



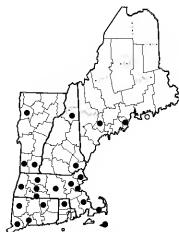
*FLAVERIA BIDENTIS*



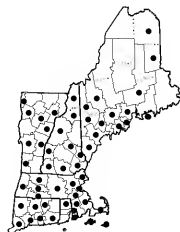
*GAILLARDIA PULCHELLA*



*GAILLARDIA X GRANDIFLORA*



*GALINSOGA PARVIFLORA*  
var. *PARVIFLORA*



*GALINSOGA QUADRIRADIATA*

Figure 21 | Distribution maps



*GAMOCHAETA PENNSYLVANICA*



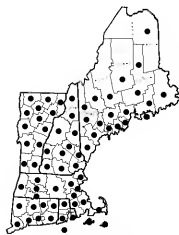
*Gamochaeta purpurea*



*GLEBIONIS CORONARIA*



*GLEBIONIS SEGETUM*



*Gnaphalium uliginosum*



*GRINDELIA HIRSUTULA*



*GRINDELIA LANCEOLATA*



*GRINDELIA SQUARROSA*



*GUTZOTIA ABYSSINICA*

Figure 22. Distribution maps



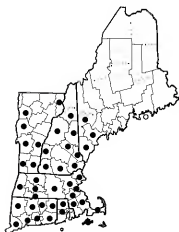
*Hasteola suaveolens*



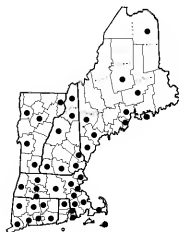
*HELENIUM AMARUM*  
var. *AMARUM*



*Helenium autumnale*



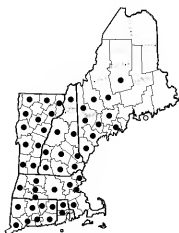
*HELENIUM FLEXUOSUM*



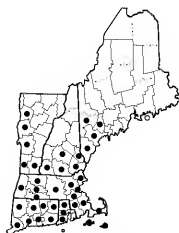
*HELIANTHUS ANNUUS*



*HELIANTHUS DEBILIS*  
subsp. *CUCUMERIFOLIUS*



*Helianthus decapetalus*



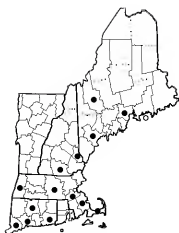
*Helianthus divaricatus*



*Helianthus giganteus*

Figure 23 Distribution maps





*HELIANTHUS GROSSEERRATUS*



*HELIANTHUS MAXIMILIANI*



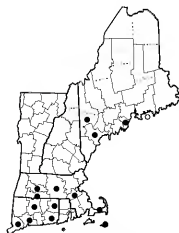
*HELIANTHUS MOLLIS*



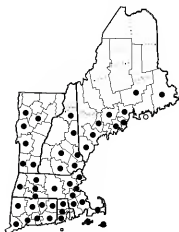
*HELIANTHUS PAUCIFLORUS*  
subsp. *PAUCIFLORUS*



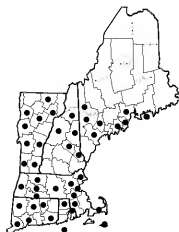
*HELIANTHUS PAUCIFLORUS*  
subsp. *SUBRHOMBOIDEUS*



*HELIANTHUS PETIOLARIS*  
subsp. *PETIOLARIS*



*Helianthus strumosus*



*HELIANTHUS TUBEROSUS*



*Helianthus x ambiguus*

Figure 24 Distribution maps



*HELIANTHUS X DIVARICERRATUS*



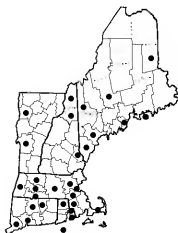
*HELIANTHUS X DORONICOIDES*



*HELIANTHUS X INTERMEDIUS*



*HELIANTHUS X KELLERMANNII*



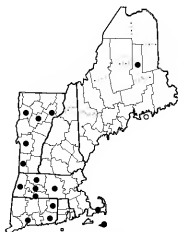
*Helianthus X LAETIFLORUS*



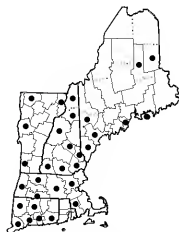
*HELIANTHUS X LUXURIANS*



*HELIOMERIS MULTIFLORA*  
var *MULTIFLORA*



*HELIOPSIS HELIANTHOIDES*  
var *HELIANTHOIDES*



*HELIOPSIS HELIANTHOIDES*  
var *SCABRA*

Figure 25 Distribution maps



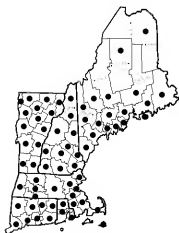
*HELMINTHOTHECA ECHOIDES*



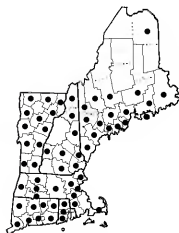
*HETEROSPERMA PINNATUM*



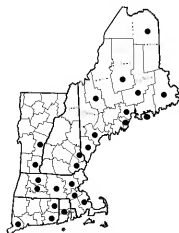
*HETEROTHECA SUBAXILLARIS*  
subsp. *LATIFOLIA*



*HIERACIUM AURANTIACUM*



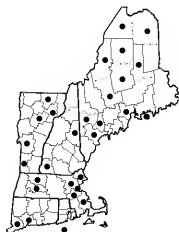
*HIERACIUM CAESPITOSUM*



*HIERACIUM FLAGELLARE*



*Hieracium gronovi*

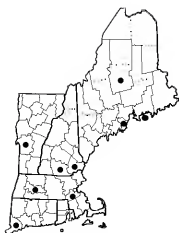


*HIERACIUM LACHENALII*

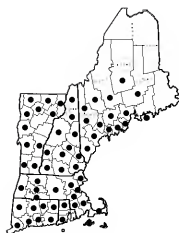


*HIERACIUM MACULATUM*

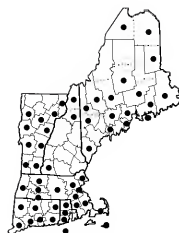
Figure 26 Distribution maps



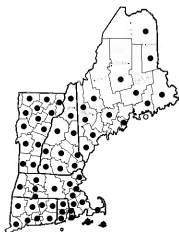
*HIERACIUM MURORUM*



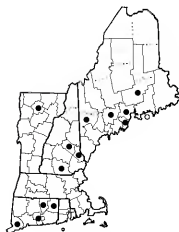
*Hieracium paniculatum*



*HIERACIUM PILOSELLA*



*HIERACIUM PILOSELLOIDES*



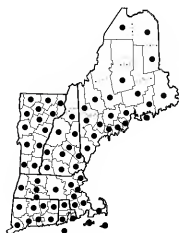
*HIERACIUM PRAEALTUM*



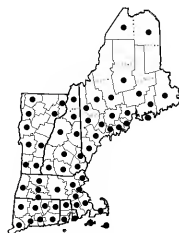
*Hieracium robinsonii*



*HIERACIUM SABAUDUM*

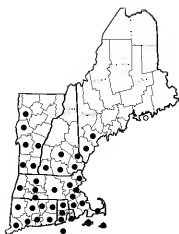


*Hieracium scabrum*



*Hieracium umbellatum*

Figure 27 Distribution maps



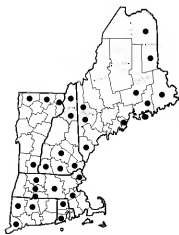
*Hieracium venosum*



*HIERACIUM X ATRAMENTARIUM*



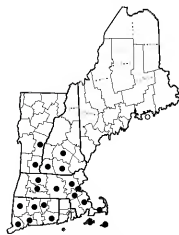
*Hieracium X fassettii*



*HIERACIUM X FLORIBUNDUM*



*HIERACIUM X FUSCOATRUM*



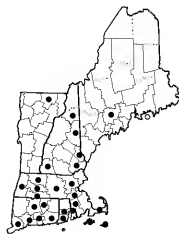
*Hieracium X marianum*



*HYMENOXYS ODORATA*

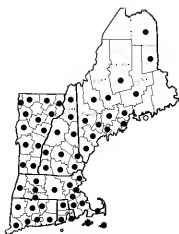


*HYPOCHAEERIS GLABRA*

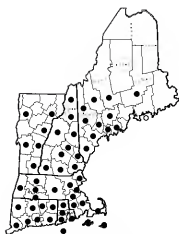


*HYPOCHAEERIS RADICATA*

Figure 28 Distribution maps



*INULA HELENIUM*



*Ionactis linearifolia*



*IVA ANNUA*



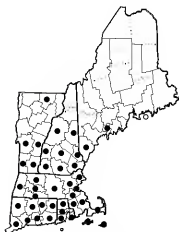
*Iva frutescens*



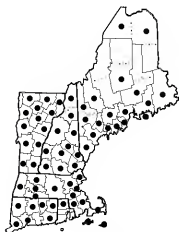
*JACOBAEA VULGARIS*



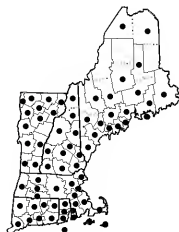
*Krigia biflora*



*Krigia virginica*

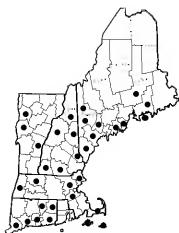


*Lactuca biennis*

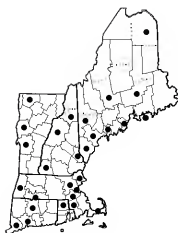


*Lactuca canadensis*

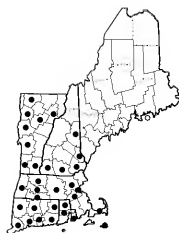
Figure 29 Distribution maps



*Lactuca hirsuta*



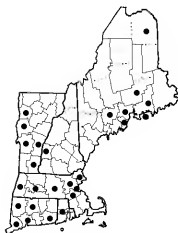
*LACTUCA SATIVA*



*LACTUCA SERRIOLA*



*Lactuca X morsum*



*LAPSANA COMMUNIS*



*LASTHENIA CALIFORNICA*  
subsp. *CALIFORNICA*



*LASTHENIA MINOR*

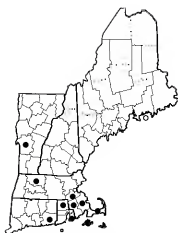


*LAYIA PLATYGLOSSA*



*LEONTODON HISPIDUS*

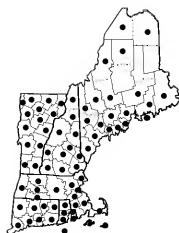
Figure 30 Distribution maps



*LEONTODON SAXATILIS*  
subsp. *SAXATILIS*



*LEUCANTHEMELLA SEROTINA*



*LEUCANTHEMUM VULGARE*



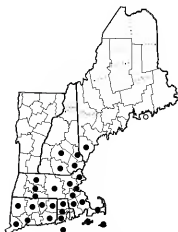
*LEUCANTHEMUM X SUPERBUM*



*LIATRIS CYLINDRACEA*



*LIATRIS PYCNOSTACHYA*  
var. *PYCNOSTACHYA*



*Liatris scariosa*  
var. *novae-angliae*



*LIATRIS SPICATA*  
var. *SPICATA*



*MADIA GLOMERATA*

Figure 31 | Distribution maps





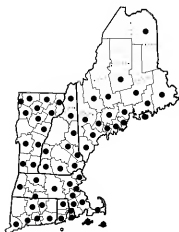
*MADIA GRACILIS*



*MADIA SATIVA*



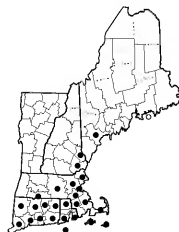
*MATRICARIA CHAMOMILLA*



*MATRICARIA DISCOIDEA*



*MICROSERIS DOUGLASII*  
subsp. *DOUGLASII*



*Mikania scandens*



*MULGEDIUM PULCHELLUM*

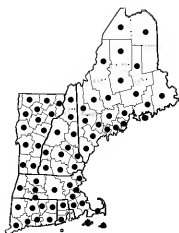


*MYCELIS MURALIS*

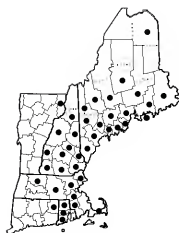


*NIPPONANTHEMUM NIPPONICUM*

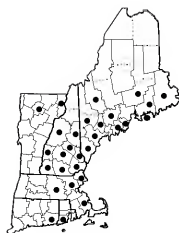
Figure 32. Distribution maps



*Oclemea acuminata*



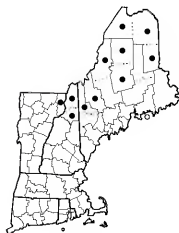
*Oclemea nemoralis*



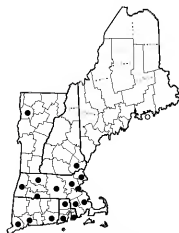
*Oclemea X blakei*



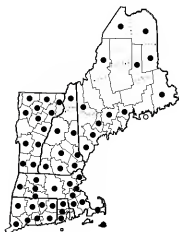
*Omalothea supina*



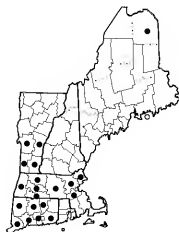
*Omalothea sylvatica*



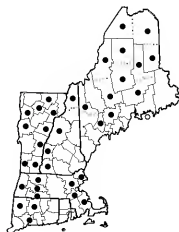
*ONOPORDUM ACANTHIUM*  
subsp. *ACANTHIUM*



*Packera aurea*

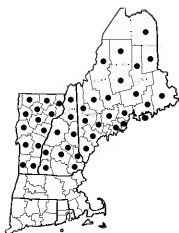


*Packera obovata*



*Packera paupercula*

Figure 33 Distribution maps



*Packera schweinitziana*



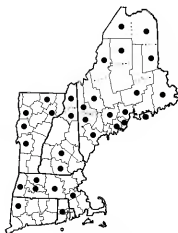
*PALAFOXIA TEXANA*



*PARTHENIUM HYSTEROPHORUS*



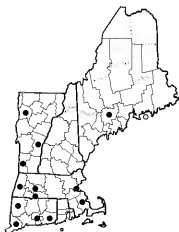
*PARTHENIUM INTEGRIFOLIUM*



*Petastix frigidus*  
var. *palmatus*



*PETASTIX HYBRIDUS*



*PICRIS HIERACIOIDES*



*Pityopsis falcata*



*PLUCHEA CAMPHORATA*

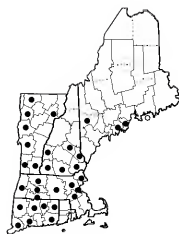
Figure 34 Distribution maps



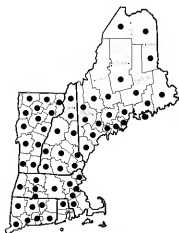
*Pluchea odorata*  
var. *succulenta*



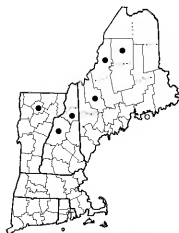
*Polymnia canadensis*



*Prenanthes alba*



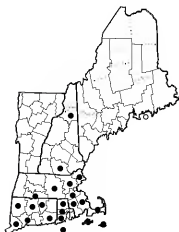
*Prenanthes altissima*



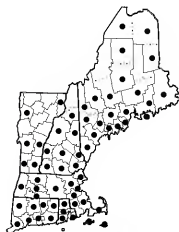
*Prenanthes boottii*



*Prenanthes racemosa*



*Prenanthes serpentina*

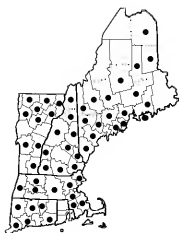


*Prenanthes trifoliolata*



*Prenanthes X mainensis*

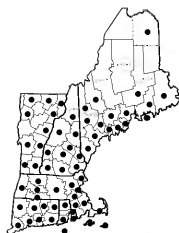
Figure 35 Distribution maps



*Pseudognaphalium macounii*



*Pseudognaphalium mucradenum*



*Pseudognaphalium obtusifolium*



*RATIBIDA COLUMNIFERA*



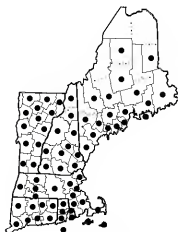
*RATIBIDA PINNATA*



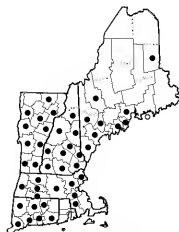
*RUDBECKIA FULGIDA*  
var. *SPECIOSA*



*Rudbeckia hirta*  
var. *hirta*



*Rudbeckia hirta*  
var. *pulcherrima*



*Rudbeckia laciniata*  
var. *laciniata*

Figure 36 Distribution maps



*RUDBECKIA SUBMONTOSA*



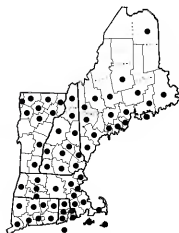
*RUDBECKIA TRILOBA*  
var. *TRILOBA*



*SANTOLINA CHAMAECYPARISSUS*



*Sclerolepis uniflora*



*SCORZONEROIDEIS AUTUMNALIS*



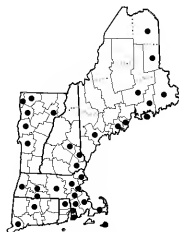
*SENECIO EREMOPHILUS*  
var. *MACDOUGALII*



*SENECIO SYLVATICUS*

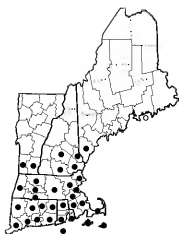


*SENECIO VISCOSUS*



*SENECIO VULGARIS*

Figure 37 Distribution maps



*Sercocarpus asteroides*



*Sercocarpus linifolius*



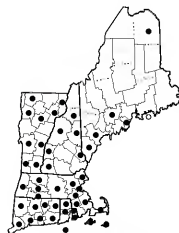
*SIGESBECKIA JORULLENSIS*



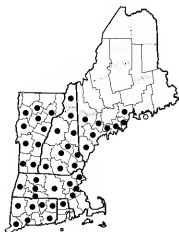
*SILPHIUM PERFOOLIATUM*  
var. *PERFOOLIATUM*



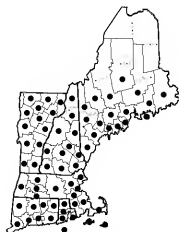
*SILYBUM MARIANUM*



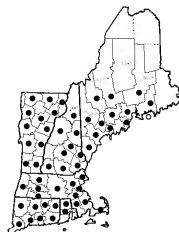
*Solidago altissima*  
subsp. *altissima*



*Solidago arguta*  
var. *arguta*

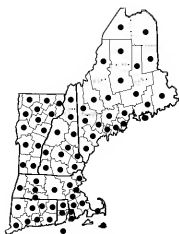


*Solidago bicolor*



*Solidago caesia*  
var. *caesia*

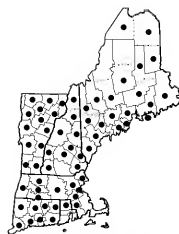
Figure 38 Distribution maps



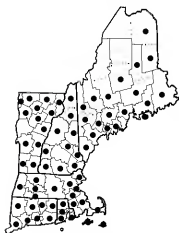
*Solidago canadensis*  
var. *canadensis*



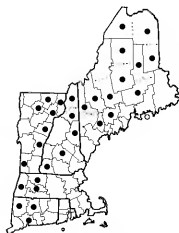
*Solidago canadensis*  
var. *hargeri*



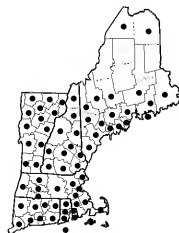
*Solidago flexicaulis*



*Solidago gigantea*



*Solidago hispida*



*Solidago juncea*



*Solidago latissimifolia*



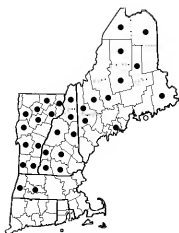
*Solidago leiocarpa*



*Solidago leptota*  
subsp. *fallax*

Figure 39 Distribution maps

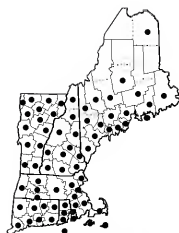




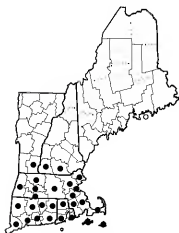
*Solidago macrophylla*



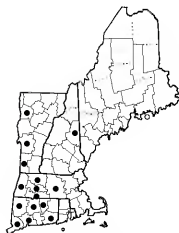
*Solidago multiradiata*



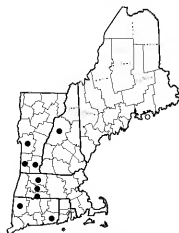
*Solidago nemoralis*  
subsp. *nemoralis*



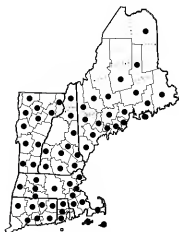
*Solidago odora*  
subsp. *odora*



*Solidago patula*  
subsp. *patula*



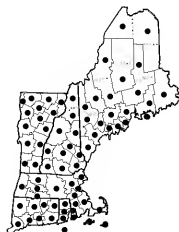
*Solidago ptarmicoides*



*Solidago puberula*  
subsp. *puberula*

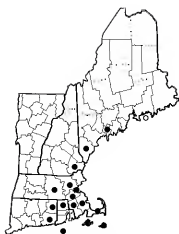


*Solidago rigida*  
subsp. *rigida*

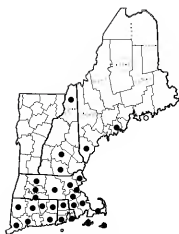


*Solidago rugosa*  
var. *rugosa*

Figure 40 Distribution maps



*Solidago rugosa*  
var. *sphagnophila*



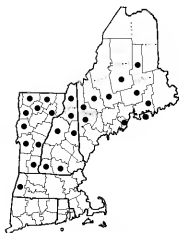
*Solidago rugosa*  
var. *aspera*



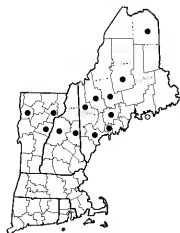
*Solidago sempervirens*  
subsp. *sempervirens*



*Solidago sempervirens*  
subsp. *mexicana*



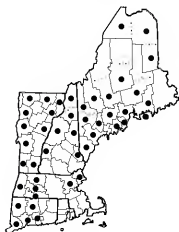
*Solidago simplex*  
var. *monticola*



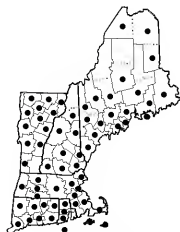
*Solidago simplex*  
var. *racemosa*



*Solidago speciosa*  
var. *speciosa*

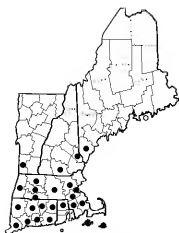


*Solidago squarrosa*



*Solidago uliginosa*

Figure 41 | Distribution maps



*Solidago ulmifolia*  
var. *ulmifolia*



*Solidago altissima* subsp. *altissima*  
x *S. rigosa* var. *rigosa*



*Solidago altissima* subsp. *altissima*  
x *S. sempervirens* subsp. *sempervirens*



*Solidago arguta* var. *arguta*  
x *S. bicolor*



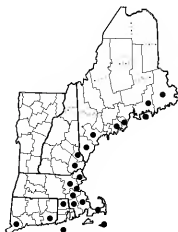
*Solidago arguta* var. *arguta*  
x *S. juncea*



*Solidago arguta* var. *arguta*  
x *S. nemoralis* subsp. *nemoralis*



*Solidago arguta* var. *arguta*  
x *S. patula* subsp. *patula*



*Solidago* x *asperula*



*Solidago bicolor*  
x *S. caesia* var. *caesia*

Figure 42. Distribution maps



*Solidago bicolor*  
*X S. hispida*



*Solidago bicolor*  
*X S. nemoralis subsp. nemoralis*



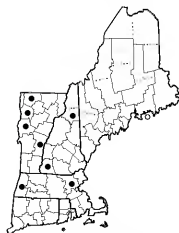
*Solidago bicolor*  
*X S. odora subsp. odora*



*Solidago bicolor*  
*X S. puberula subsp. puberula*



*Solidago bicolor*  
*X S. rugosa var. rugosa*



*Solidago caesia var. caesia*  
*X S. flexicaulis*



*Solidago caesia var. caesia*  
*X S. juncea*



*Solidago caesia var. caesia*  
*X S. rugosa var. rugosa*



*Solidago X calcicola*

Figure 43 Distribution maps



*Solidago canadensis* var. *canadensis*  
*X S. gigantea*



*Solidago canadensis* var. *canadensis*  
*X S. juncea*



*Solidago canadensis* var. *canadensis*  
*X S. rugosa*



*Solidago canadensis* var. *hargeri*  
*X S. rugosa* var. *rugosa*



*Solidago gigantea*  
*X S. rugosa* var. *rugosa*



*Solidago gigantea*  
*X S. sempervirens* subsp. *sempervirens*



*Solidago juncea*  
*X S. nemoralis* subsp. *nemoralis*



*Solidago juncea*  
*X S. sempervirens* subsp. *sempervirens*



*Solidago latissimifolia*  
*X S. rugosa* var. *sphagnophila*

Figure 44 Distribution maps



*Solidago leiocarpa*  
*X.S. simplex* var. *monticola*



*Solidago macrophylla*  
*X.S. rugosa* var. *rugosa*



*Solidago nemoralis* subsp. *nemoralis*  
*X.S. sempervirens* subsp. *sempervirens*



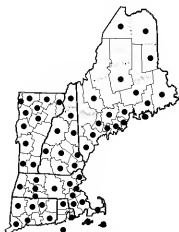
*Solidago nemoralis* subsp. *nemoralis*  
*X.S. speciosa* var. *speciosa*



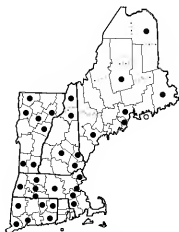
*Solidago odora* subsp. *odora*  
*X.S. rugosa* var. *rugosa*



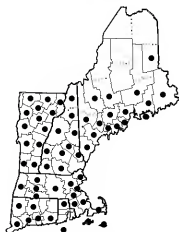
*Solidago rugosa* var. *rugosa*  
*X.S. ulmifolia* var. *ulmifolia*



*SONCHUS ARVENSIS*  
subsp. *ARVENSIS*

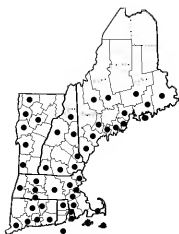


*SONCHUS ARVENSIS*  
subsp. *ULIGINOSUS*



*SONCHUS ASPER*

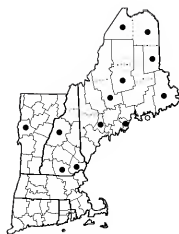
Figure 45 Distribution maps



*SONCHUS OLERACEUS*



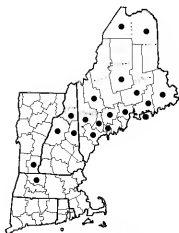
*Symphyotrichum antiochiense*



*Symphyotrichum boreale*



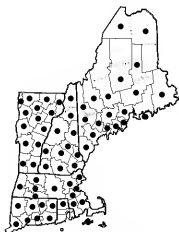
*SYMPHYOTRICHUM CILIATUM*



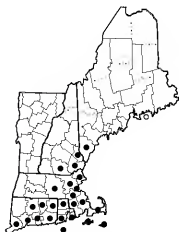
*Symphyotrichum ciliolatum*



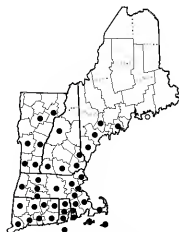
*Symphyotrichum concolor*  
var. *concolor*



*Symphyotrichum cordifolium*



*Symphyotrichum dumosum*



*Symphyotrichum ericoides*  
var. *ericoides*

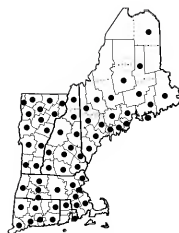
Figure 46 Distribution maps



*SYMPHYOTRICHUM FRONDOSUM*



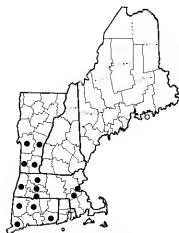
*Symphyotrichum laeve*  
var. *laeve*



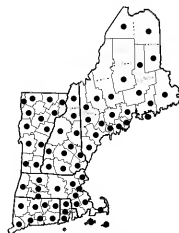
*Symphyotrichum lanceolatum*  
var. *lanceolatum*



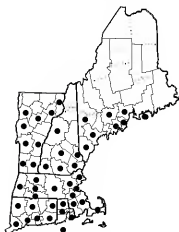
*Symphyotrichum lanceolatum*  
var. *interior*



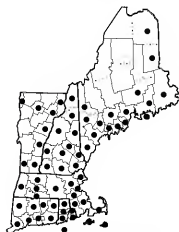
*Symphyotrichum lanceolatum*  
var. *latifolium*



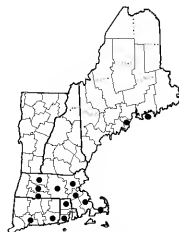
*Symphyotrichum lateriflorum*



*Symphyotrichum novae-angliae*



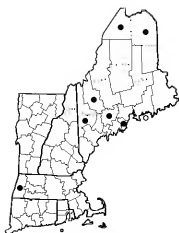
*Symphyotrichum novi-belgii*  
var. *novi-belgii*



*Symphyotrichum novi-belgii*  
var. *elodes*

Figure 47 Distribution maps

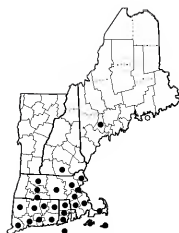




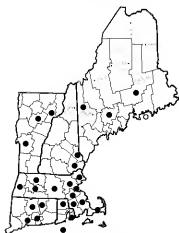
*Symphyotrichum novi-belgii*  
var. *villicaule*



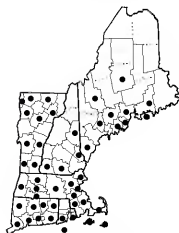
*Symphyotrichum ontarionis*  
var. *ontarionis*



*Symphyotrichum patens*  
var. *patens*



*Symphyotrichum pilosum*  
var. *pilosum*



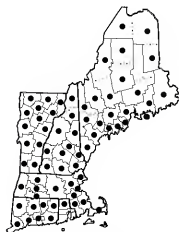
*Symphyotrichum pilosum*  
var. *pringlei*



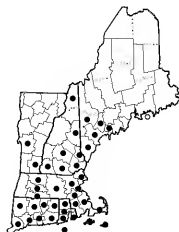
*Symphyotrichum praecox*  
var. *praecox*



*Symphyotrichum prenanthoides*

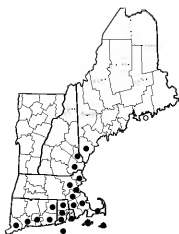


*Symphyotrichum puniceum*  
var. *puniceum*



*Symphyotrichum racemosum*

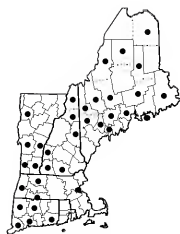
Figure 48 Distribution maps



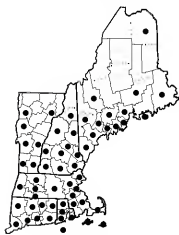
*Symphyotrichum subulatum*  
var. *subulatum*



*Symphyotrichum tenuifolium*  
var. *tenuifolium*



*Symphyotrichum tradescanti*



*Symphyotrichum undulatum*



*Symphyotrichum urophyllum*



*Symphyotrichum X anethystum*



*Symphyotrichum ciliolatum*  
*X S. prenanthoides*



*Symphyotrichum ciliolatum*  
*X S. puniceum* var. *puniceum*



*Symphyotrichum cordifolium*  
*X S. ericoides* var. *ericoides*

Figure 49 Distribution maps



*Symphyotrichum cordifolium*  
*X S. lateriflorum*



*Symphyotrichum cordifolium*  
*X S. novi-belgii* var. *novi-belgii*



*Symphyotrichum cordifolium*  
*X S. pilosum* var. *pringlei*



*Symphyotrichum cordifolium*  
*X S. puniceum* var. *puniceum*



*Symphyotrichum cordifolium*  
*X S. undulatum*



*Symphyotrichum dumosum*  
*X S. lateriflorum*



*Symphyotrichum dumosum*  
*X S. puniceum* var. *puniceum*

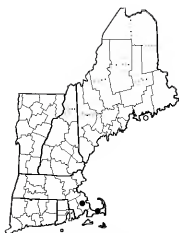


*Symphyotrichum dumosum*  
*X S. racemosum*



*Symphyotrichum dumosum*  
*X S. tradescanti*

Figure 50 Distribution maps



*Symphyotrichum ericoides* var. *ericoides*  
*X S. novi-belgii* var. *novi-belgii*



*Symphyotrichum ericoides* var. *ericoides*  
*X S. undulatum*



*Symphyotrichum laeve* var. *laeve*  
*X S. lanceolatum* var. *lanceolatum*



*Symphyotrichum laeve* var. *laeve*  
*X S. praecox*



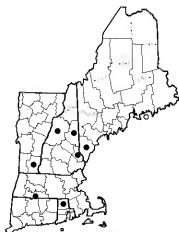
*Symphyotrichum laeve* var. *laeve*  
*X S. racemosum*



*Symphyotrichum laeve* var. *laeve*  
*X S. undulatum*



*Symphyotrichum lanceolatum* var. *lanceolatum*  
*X S. novae-angliae*



*Symphyotrichum lanceolatum* var. *lanceolatum*  
*X S. novi-belgii* var. *novi-belgii*



*Symphyotrichum lanceolatum* var. *lanceolatum*  
*X S. pilosum* var. *pringlei*

Figure S1 | Distribution maps



*Symphyotrichum lanceolatum* var. *lanceolatum*  
X.S. *praetium*



*Symphyotrichum lanceolatum* var. *lanceolatum*  
X.S. *puniceum* var. *puniceum*



*Symphyotrichum lanceolatum* var. *lanceolatum*  
X.S. *tradescanti*



*Symphyotrichum lateriflorum*  
X.S. *novi-belgii* var. *novi-belgii*



*Symphyotrichum lateriflorum*  
X.S. *puniceum* var. *puniceum*



*Symphyotrichum lateriflorum*  
X.S. *racemosum*



*Symphyotrichum lateriflorum*  
X.S. *undulatum*



*Symphyotrichum novi-belgii* var. *novi-belgii*  
X.S. *pilosum* var. *pilosum*



*Symphyotrichum novi-belgii* var. *novi-belgii*  
X.S. *praetium*

Figure S2. Distribution maps



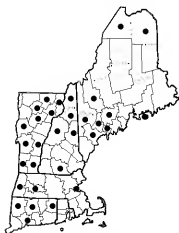
*Symphyotrichum novi-belgii* var. *novi-belgii*  
*X S. prenanthoides*



*Symphyotrichum novi-belgii* var. *novi-belgii*  
*X S. puniceum* var. *puniceum*



*Symphyotrichum pilosum* var. *pilosum*  
*X S. undulatum*



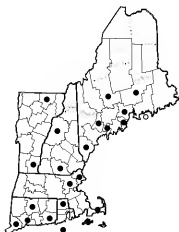
*Symphyotrichum X tardiflorum*



*TAGETES ERECTA*



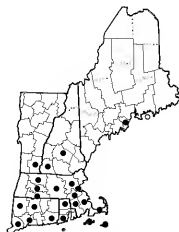
*TAGETES MINUTA*



*TANACETUM BALSAMITA*

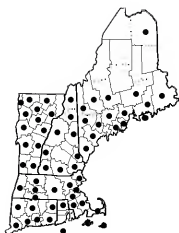


*Tanacetum bipinnatum*

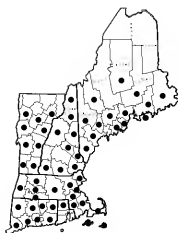


*TANACETUM PARTHENIUM*

Figure 53 Distribution maps



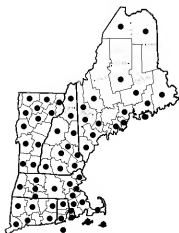
*TANACETUM VULGARE*



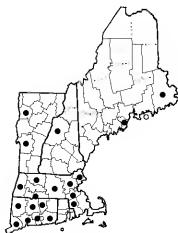
*TARAXACUM ERYTHROSPERMUM*



*Taraxacum latilobum*



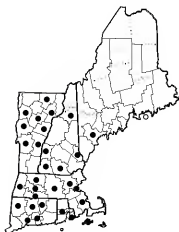
*TARAXACUM OFFICINALE*



*TARAXACUM PALUSTRE*



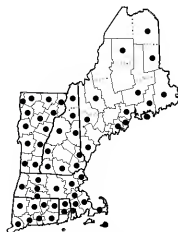
*THYMOPHYLLA TENUILOBA*  
var. *TENUILOBA*



*TRAGOPOGON DUBIUS*

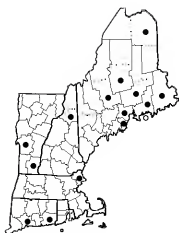


*TRAGOPOGON PORRIFOLIUS*



*TRAGOPOGON PRATENSIS*

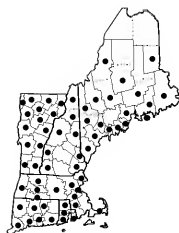
Figure 54 Distribution maps



*TRIPLEUROSPERMUM INODORUM*



*TRIPLEUROSPERMUM MARITIMUM*  
subsp. *MARITIMUM*



*TUSSILAGO FARFARA*



*Verbesina alternifolia*



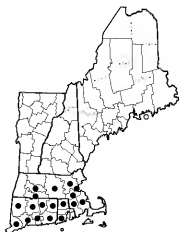
*VERBESINA ENCELIOIDES*



*VERNONIA FASCICULATA*



*VERNONIA MISSURICA*



*Vernonia noveboracensis*



*VERNONIA X PERALTA*

Figure 55 Distribution maps

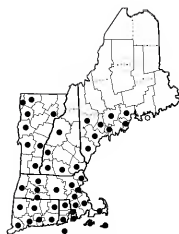




*XANTHISMA GRACILE*



*XANTHUM SPINOSUM*



*Xanthum strumarium*



*XEROCHRYSIUM BRACTEATUM*



*ZINNIA ELEGANS*

Figure 56. Distribution maps

**REDUCTION OF *DIPLYCOSIA INDICA* (2009) TO  
*GAULTHERIA AKAENSIS* (2006) (ERICACEAE)**

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**ABSTRACT**

*Diplycosia indica* M.R. Debta & H.J. Chowdhery is reduced to synonymy under *Gaultheria akaensis* Panda & Sanjappa due to a misinterpretation of immature floral features of the type material used by Debta and Chowdhery to establish their new species.

**KEY WORDS:** nomenclature, synonymy, India, Singalelah National Park

*Diplycosia indica* was described by Debta and Chowdhery (2009) based on two specimens collected by M.R. Debta in the Singalelah National Park area of the Darjeeling Himalaya. During the course of recent field studies (mid-December 2011) at different locations in Singalelah National Park as part of post-revisionary work in Indian Ericaceae, specimens of a species of *Gaultheria* L. were collected near Megma, Megma-Tonglu road and in the Kainyakata-Kalapokhri area on rocky slopes near adjacent road sides. The *Gaultheria* was identified as *G. akaensis* Panda & Sanjappa (2006), a critically endangered species then known only from Aka Hill in the Arunachal Himalaya. This expression of *G. akaensis* from the Singalelah National Park then proved to be identical to the type of *D. indica*, which also was collected on hilly slopes in the Kainyakata-Kalapokhri area.

Surprisingly, during the consultation of the type specimens of *Diplycosia indica* at CAL and BSD, it was noted that the validating description and associated line drawing published by Debta and Chowdhery did not match features of the type specimens. Observations were made on different populations of *Diplycosia indica*/*Gaultheria akaensis* flowering in discontinuous patches from Megma to Tonglu and from Kainyakata to Kalapokhri, although Debta and Chowdhery (p. 149) stated that “the new species could not be traced from anywhere inside the Singalila [=Singalelah] National Park except for a small population.” Here we provide a comparison of *G. akaensis* from two locations with the two specimens cited when *D. indica* was established to demonstrate that only a single species is involved (Table 1).

### Taxonomic treatment

***Gaultheria akaensis*** Panda & Sanjappa, Edinburgh J. Bot. 63: 15–20. 2006. TYPE: INDIA. Arunachal Pradesh, Aka Hills, West Kameng district, 3 km from Nechephu, 27 km towards Tenga, left bank of the bridge, 1800 m, 25 Dec 2002, *S. Panda 30824* (holotype: CAL!; isotype: CAL!). Fig. 1.

*Diplycosia indica* M. R. Debta & H. J. Chowdhery, J. Bot. Res. Inst. Texas 3: 147. 2009. TYPE: INDIA. West Bengal, Darjeeling, Singalila [=Singalelah] National Park, Kainyakata to Kalapokhri, ca. 2950 m, 2 Jun 2006, *M.R.Debta 40813* (holotype: CAL!; isotype: BSD!). Fig. 2.

**Distribution.** Endemic to the eastern Himalaya of India (Darjeeling in West Bengal and Arunachal Pradesh).

**Habitat.** This species is extremely rare and threatened in subtropical-temperate forests at an altitude of about 2250–3000 m associated with *Gaultheria stappiana* Airy Shaw, various species of *Rhododendron*, and *Quercus leucotrichophora* A. Camus ex Bahadur. Fig. 3.

**Flowering.** June; December. **Fruiting.** July–August; January.

**Specimens examined.** INDIA. Eastern Himalaya-Arunachal Pradesh: Aka Hills, West Kameng district, 3 km from Nechephu, 27 km towards Tenga, left bank of the bridge, 1800 m, 25 Dec 2002, *S. Panda 30824* (CAL; type of *Gaultheria akaensis*). West Bengal: Darjeeling district, Singalilah National Park, 3 km from Chitray toward Megma, 2300 m, 11 Dec 2011, *S. Panda 78* (CAL); 7 km from Chitray toward Megma, 2400 m, 11 Dec 2011, *S. Panda 79* (CAL); Kainyakata-Kalapokhri road, 2900 m, 12 Dec 2011, *S. Panda 80* (CAL); Kainyakata to Kalapokhri, 2950 m, 2 Jun 2006, *M. R. Debta 40813* (BSD, CAL; type material of *Diplycosia indica*).

### Discussion

It is concluded that the description of *Diplycosia indica*, as given by Debta and Chowdhery (2009), does not conform to their type materials due to their misinterpretation of the floral features associated with immature flower buds. They presented and described a mature flower which is not associated with their type material, although vegetatively their description conforms with collections made by the senior author (*S. Panda 78, 79, 80*; CAL) from Singalilah National Park, including the type location cited by Debta and Chowdhery.

*Diplycosia indica* does not possess any generic characters of *Diplycosia* Blume, namely a fasciculate inflorescence, awnless anther lobes, and anthers with tubules. Rather the type specimens of Debta and Chowdhery possess the generic characters of *Gaultheria*. Without doubt, their assumption that the anther lobes were awnless was due to the immature nature of the flowers, as an awnless condition is not unusual in immature flowers of some species of *Gaultheria*. From Table 1, it is also concluded that while geographically isolated from *G. akaensis*, the Darjeeling populations of *D. indica* are nearly identical with the Arunachal population of *G. akaensis* except for leaf shape. The Arunachal population of *G. akaensis* has slightly larger ovate to ovate-elliptic lamina and a reduced number of stamens (5–7) while the Darjeeling populations have a slightly shorter elliptic to ovate-elliptic lamina and more stamens (10). As variation in leaf shape is to be expected, and differences in anther numbers are not uncommon in *Gaultheria*, we conclude that *D. indica* is a heterotypic synonym *G. akaensis*.

Figure 1. Holotype of *Gaultheria akaensis* Panda & Sanjappa (CAL). Arunachal population

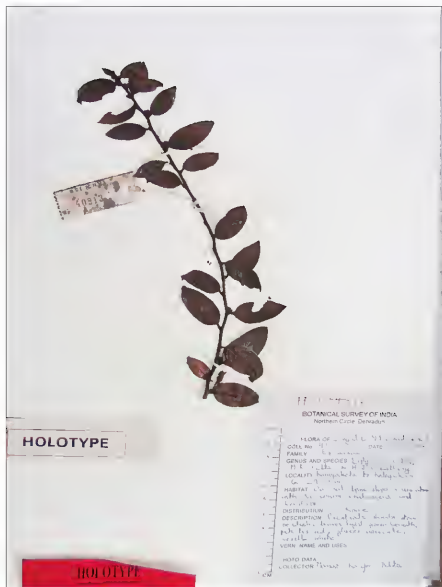


Figure 2. Holotype of *Diplycosia indica* M.R. Debta & H.J. Chowdhery (CAL). Darjeeling population.

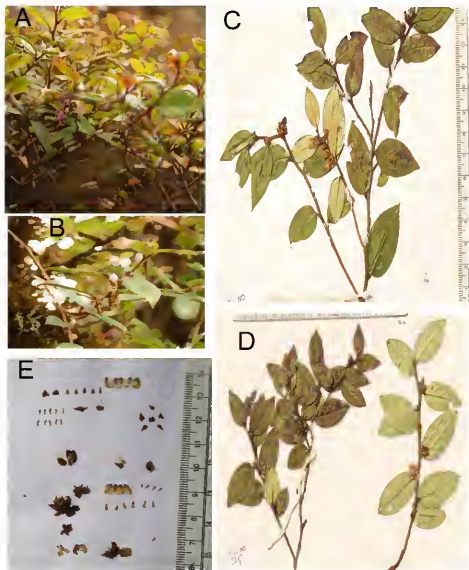


Figure 3. Live plants of *Gaultheria akaensis*. Darjeeling populations. A–B Habit (part). C–D. Flowering twigs (close up). E Dissected floral parts

**Table 1.** Comparison among *Diplycosia indica*, *Gaultheria akaensis* (Arunachal population) and *G. akaensis* (Darjeeling population) – see also Fig. 3.

<b>Unique characters</b>	<b><i>Diplycosia indica</i> (M.R. Debita 40813: CAL &amp; BSD) Darjeeling population</b>	<b><i>Gaultheria akaensis</i> (S. Panda 30824: CAL) Arunachal Population</b>	<b><i>G. akaensis</i> (S. Panda 78, 79, 80: CAL) Darjeeling populations</b>
<b>Habit</b>	Prostrate shrub up to 1.5 m high	Prostrate-decumbent mat-forming stout shrub up to 1 m high	Prostrate-decumbent mat-forming stout shrub up to 1 m high
<b>Stem</b>	Terete, laxly to densely brown hirsute or setose, reddish	Terete, densely brown hispid-setose, branchlets blood-red to dark pink	Terete, densely brown hispid-setose, branchlets blood-red to dark pink
<b>Lamina</b>	Subcoriaceous; elliptic to ovate-elliptic, 13–36×7–18 mm, mucronate at apex, serrulate margin with short cilia up to 1 mm long.	Papery to subcoriaceous; ovate to ovate-elliptic, (15) 25–42×16–28 mm, mucronate at apex; serrulate margin with long cilia up to 5 mm long.	Subcoriaceous, elliptic, ovate-elliptic to oblong-elliptic, 12–46×10–22 mm, mucronate at apex; serrulate margin with short cilia up to 1 mm long.
<b>petioles</b>	1.5–3 mm long, densely hispid-setulose, reddish	2–3 mm long, setulose, reddish	2–3 mm long, densely hispid-setulose, pink
<b>Inflorescence</b>	Congested and short racemes with fascicle of 3–6-flowered	Congested and short racemes with fascicle of 4–5-flowered	Congested and short racemes with fascicle of 4–5-flowered
<b>Flower</b>	Not on type material but 6–8 mm long, urceolate with 1 basal bract and 2 opposite and apical bracteoles as per description	8 mm long, urceolate with 1 basal bract and 2 opposite and median bracteoles	6–8 mm long, urceolate with 1 basal bract and 2 opposite and apical bracteoles
<b>Calyx lobes</b>	5-lobed, each lobe ovate-triangular, 3×1.5 mm, puberulous	5-lobed, each lobe ovate-triangular, 2×1 mm, glabrous	5-lobed, each lobe ovate-triangular, 3×1.5 mm, puberulous
<b>Corolla</b>	Not seen but as per description: 4 mm long (due to mature flower bud), urceolate, white, glabrous	5 mm long, urceolate, light pink to white, glabrous	5 mm long, urceolate, light pink to white with purple stripes at apex; glabrous
<b>Stamens</b>	Not seen but as per description: 10, encircling round the pistil, loosely epipetalous, 1.5 mm long (due to immaturity), each lobe of anthers without awns (due to immature flower buds); no apical tubule seen	5 (7), encircling round the pistil, loosely epipetalous, 2 mm long, each lobe of anthers with 2 minute apical awns, no apical tubule seen.	10, encircling round the pistil, free (not epipetalous), 2.5 mm long, each lobe of anthers with 2 minute apical awns, no apical tubule seen.
<b>Pistil</b>	2.5–3.5 mm long, ovary 1×1.5 mm, scarcely puberulous	3.5 mm long, ovary 1×1 mm, densely puberulous	3.5 mm long, ovary 1×1.5 mm, densely puberulous
<b>Fruit</b>	Not seen.	Immature fruits: loculicidally 5-valved capsule, 3×3 mm	Immature fruits: loculicidally 5-valved capsule, 3×2 mm

#### ACKNOWLEDGMENTS

One of us (SP) is grateful to the Additional Director of the Central National Herbarium, Dr. P. Venu, for his permission to consult herbarium and type specimens at CAL, to Prof. Lalita Rai Ahmed, Principal of Darjeeling Govt. College for her kind permission for field survey, and to Dr. S. Mukhopadhyay, Assistant Prof. of Bengali, Darjeeling Govt. College, for company during the field trek to Singalelah National Park.

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- Panda, S. and M. Sanjappa. 2006. Two new species of *Gaultheria* (Ericaceae) from India. Edinburgh J. Bot. 63: 15–20.



## EXAMINATION OF HYBRIDIZATION RELATIONSHIPS BETWEEN *SCHOENOPLECTUS HALLII* AND *S. SAXIMONTANUS* (CYPERACEAE) USING ISSR MARKERS

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### ABSTRACT

*Schoenoplectus hallii*, commonly known as Hall's bulrush, is an annual species restricted to wetland habitats that experience fluctuating water levels. This rare annual has suffered significant population losses over the last 25 years and the survival and conservation of the taxon is a concern wherever it has been reported. Although habitat loss has been the main reason for the decline of *S. hallii*, hybridization appears to be a new threat to the survival of the species. Putative hybridization has been reported between *S. hallii* and *S. saximontanus* where the two species co-occur in some sites in Oklahoma. We examined individuals from both species and putative hybrids from the Wichita Mountains Wildlife Refuge and adjacent areas on the Fort Sill Military Reservation in Oklahoma using three ISSR primers. We identified six species-specific markers in *S. saximontanus* and nine in *S. hallii*, all of which were present in the putative hybrids plants. Our results support previous studies suggesting that the two species are hybridizing in Oklahoma and that hybridization could occur in other areas where populations overlap.

**KEY WORDS:** *Schoenoplectus*, hybridization, ISSR markers, conservation

*Schoenoplectus hallii* (A. Gray) S.G. Sm and *S. saximontanus* (Fernald) Raynal are sedge species that were once thought to be allopatric, with *S. hallii* occurring primarily in the Midwest and eastern USA and *S. saximontanus* largely confined to the western portions of the USA (Gleason & Cronquist 1991; Beatty et al. 2004). Both species belong to *Schoenoplectus* sect. *Supini* (Chern.) J. Raynal. *Schoenoplectus hallii* has a global ranking of G2/G3 (impaired/vulnerable) and is listed as “critically imperiled” in eight of the 11 states in which it occurs, “impaired” in two, and “vulnerable” in one. Herbarium records indicate that it had been reported from Georgia and Massachusetts prior to 1981 (McKenzie et al. 2007), but those populations are likely extirpated (NatureServe 2011; McKenzie et al. 2007). *Schoenoplectus saximontanus* has a global ranking of G5 (secure) (NatureServe 2011), but it is listed as “critically imperiled” in British Columbia as well as in 7 of the 11 states where it occurs. It has been reported from two states in Mexico (Smith 2002). Throughout

its range, *S. saximontanus* is considered to be an uncommon species whose distribution is scattered (Smith 2002).

*Schoenoplectus hallii* and *S. saximontanus* are obligate wetland species that have similar habitat requirements — most often sandy, rocky or gravelly soil, occasionally clay, around the margins of ponds, ditches and swales with fluctuating water levels, and a scarcity of other plants as competitors (Smith 2002; McKenzie et al. 2007). They most commonly complete their life cycle as annuals, but short-lived perennials have been reported from Texas (O’Kennon & McLennore 2004). Dispersal within and among sites is thought to be facilitated by migrating waterfowl and a variety of large mammals, including elk, cattle, bison, and feral pigs (Magrath 2002; McKenzie et al. 2007).

Both species have 2–3 small basal leaves and tufted stems about 4–40 cm long with small, inconspicuous rhizomes. The species are amphicarpic (having two distinct types of achenes), with numerous inflorescences on aerial stems containing perfect flowers, and occasional pistillate flowers enclosed in a leaf sheath at the base (Smith 2002). Although it is difficult to distinguish between the species vegetatively, the achenes of *Schoenoplectus hallii* are 2-sided and flowers have 2-lobed styles, whereas, achenes of *S. saximontanus* are 3-sided and flowers have 3-lobed styles (Smith 2002). Achenes of both species have transverse ridging, but Magrath (2002) and Smith and McKenzie (2011) reported that the ridges on *S. saximontanus* are “winged,” while those on *S. hallii* are smooth.

Five states (Kansas, Missouri, Nebraska, Oklahoma, and Texas) have populations of both species (NatureServe 2011); however, only Oklahoma (Magrath 2002), Kansas (Craig Freeman pers. comm. 2006) and Texas (Bob O’Kennon, pers. comm. 2007) have sites with mixed populations. Although *Schoenoplectus saximontanus* occurs in eight counties in Oklahoma, it co-occurs with *S. hallii* in only Comanche County (Oklahoma Vascular Plant Database 2012). In 2000, 134 sites at the Wichita Mountains Wildlife Refuge (WMWR) in Comanche County were surveyed for *S. hallii* and *S. saximontanus* (Magrath 2002). At that time no evidence of hybrids was reported (Magrath 2002; McKenzie et al. 2007). Young (2002) examined plants from two sites on the WMWR using amplified fragment length polymorphism (AFLP) data. She indicated there was no evidence for gene flow or hybridization between the taxa but acknowledged the possibility of hybridization.

In August 2001, Smith re-examined the population sites surveyed by Magrath in 2000 and noted plants that she identified as potential hybrids. In 2002, Smith and McKenzie returned to the site and collected voucher specimens and individuals for a laboratory study. Some plants had achenes that appeared to be 2-sided like those of *Schoenoplectus hallii*, except the usually flat or convex side contained a conspicuous bulge and the achene ridges often had the “winged” appearance reported by Magrath (2002). Other individuals had both 2- and 3-lobed styles with corresponding 2- or 3-sided achenes, with winged ridges present on some but lacking on others. Other plants produced only a few viable-looking achenes, with the majority of inflorescences bearing a preponderance of aborted achenes. Based on these observations, Smith et al. (2004) reported the first recorded observation of the putative hybrid, *Schoenoplectus hallii* x *S. saximontanus*.

In subsequent years (2007–2010), Smith and McKenzie conducted surveys and collected specimens of *Schoenoplectus* from selected sites on the WMWR and on adjacent areas of the Fort Sill Military Reservation (FSMR) (Smith & McKenzie 2011). At all four sites where the species occurred in mixed populations, putative hybrids were present. From 2007 to 2010, the relative number of hybrids at mixed sites increased compared to *S. hallii* and *S. saximontanus*. At one population site, neither parent species was present in 2010, but the putative hybrid was abundant (Smith & McKenzie 2011).

### Molecular markers and ISSRs

A molecular marker that has proven useful in genetic diversity studies is inter-simple sequence repeats (ISSRs) (Esselman et al. 1999). Unlike some other molecular markers, ISSRs require no prior knowledge of the exact DNA sequence (Godwin et al. 1997), show more genetic diversity (Nagaoka and Ogihara 1997), and are an effective means for examining similarities or differences between species (Esselman et al. 1999). ISSR marker analyses have been used in conjunction with morphological characteristics to examine hybridization between the mustard family species *Physaria bellii* Mulligan and *P. vitulifera* Rydberg (Kothera et al. 2007).

The objective of this report is to present DNA evidence to confirm the existence of hybridization between *Schoenoplectus hallii* and *S. saximontanus*. We used the identification of ISSR markers for *S. hallii* and *S. saximontanus* present in putative hybrids as a criterion for confirming hybridization in plants collected from sites in the WMWR and FSMR in Oklahoma where the parental species co-occur (Smith et al. 2004, McKenzie et al. 2007, Smith & McKenzie 2011).

### MATERIALS AND METHODS

Parent and hybrid plant material was collected from the WMWR site in 2008 and 2009. Ten additional hybrid plants collected from the FSMR site in 2010 were included in our analysis. Smith and McKenzie (2011) noted that while the parental species had been present in past years at the FSMR site, only hybrid plants were present in 2010. For this reason, only hybrid plants are included in our analysis from this site.

	9-18-2008	8-25-2009	TOTAL
<i>S. hallii</i>	10	14	24
Hybrids	12	8	20
<i>S. saximontanus</i>	14	0	14
	9-18-2008	8-25-2009	TOTAL

Table 1. Number of plants examined with ISSR markers from the Wichita Mountains Wildlife Refuge (WMWR), Oklahoma.

Species and putative hybrid identification was made in the field using a hand lens to examine achene morphology. All voucher specimens are deposited at the Missouri Botanical Garden (MO) with duplicates distributed to other herbaria. The number of plants collected per year and the total number of plants examined is as listed in Table 1.

Culms were dried in silica gel at the collection sites and processed in the laboratory of Dr. Esselman at Southern Illinois University Edwardsville. They were frozen with liquid nitrogen and stored at -80 °C until DNA was extracted using Dneasy miniprep kits from Qiagen. The ISSR reactions protocols follow Esselman et al. (1999). The primer designations and compositions [17898 (CA) 6RY, 17899 (CA) 6RG, and 17901 (GT) 6YR] were obtained from GenoSys. Bands amplified by PCR were characterized on 1.5% agarose gels in 1x Tris-borate-EDTA buffer. Gels were stained with ethidium bromide. A 100 bp ladder (Gibco/BRL) was run with the PCR generated fragments to determine band sizes. All samples were run at least twice for every primer to ensure band reproducibility.

The gels were read and analyzed using the Bio-Rad Gel Doc XR Molecular Imager. Band presence values were entered into a program written by Vera Ford, UC-Davis to generate average pairwise similarity values.

## RESULTS

A total of 60 bands were scored. Primer 17898 revealed a total of 22 bands, Primer 17899 revealed 21 bands, and Primer 17901 had seventeen bands scored (Table 2). We found six bands unique to *Schoenoplectus saximontanus* and nine unique to *S. halimii* (Table 2). These bands were found to be reliable species markers in that they were consistently present in the parental plants. Both sets of bands were found in the hybrid plants from WMWR and FSMR populations.

Primer	Bands per primer	Hybrids Only	<i>S. saximontanus</i> and hybrids	<i>S. halimii</i> and hybrids
17898	22	2 (275 and 750 bp*)	1 (550 bp)	2 (650bp/700bp)
17899	21	2 (900 and 1400 bp)	3 (450, 550 and 1100bp)	4 (850, 1200, 1500, and 2320bp)
17901	17	0	1 (625)	2 (1500 and 2122)
Total	60	4	6	9

Table 2. Total number of bands per primer, numbers of unique bands per species and number of the unique bands present in the hybrid plants. \*Band unique to FSMR.

Three bands were found to be unique to the hybrids at both sample sites. The FSMR plants contained one additional unique band (17898, 750bp). We did not see complete additivity in any of the hybrids examined from either site.

The distance values for all populations analyzed using ISSR markers are presented in Table 3. A distance value of one indicates complete ISSR marker similarity among compared individuals. The highest similarities occur in the within taxa comparisons. Individuals of *Schoenoplectus halimii* are the most genetically similar to other *S. halimii* plants (0.823), as also is the case with *S. saximontanus* (0.725). The FSMR hybrid plants have next highest within group similarity (0.697), followed closely in similarity to the *S. halimii* from the WMWR (0.694). The highest within group diversity was observed in the WMWR hybrids (0.628).

	<i>S. halimii</i>	WMWR hybrids	<i>S. saximontanus</i>	FSMR hybrids
<i>S. halimii</i>	<u>0.823</u>			
WMWR hybrids	0.616	<u>0.628</u>		
<i>S. saximontanus</i>	0.545	0.648	<u>0.725</u>	
FSMR hybrids	0.694	0.597	0.536	<u>0.697</u>

Table 3. Average pairwise similarity values in comparison within and among taxa. A similarity value of 1 indicates complete similarity, while a value of 0 indicates no similarity. Within group similarity values are underlined.

In among-group comparisons, the most similar were the FSMR hybrids and *Schoenoplectus halimii* (0.694), followed by the WMWR hybrids and *S. saximontanus* (0.648). The lowest similarity values were seen when comparing *S. saximontanus* with the FSMR (0.536) hybrids and the next least similar taxa were *S. saximontanus* and *S. halimii* (0.545).

## DISCUSSION

### Species specific markers

Support for hybridization between the two taxa was evidenced by species specific ISSR markers present in parental and hybrid plants. We were able to find markers specific for each species: *Schoenoplectus hallii* (9 markers) and *S. saximontanus* (6 markers) (Table 2).

Archdale et al. (2010) and Stapay et al. (2011) previously demonstrated that identical ISSR markers were present in other populations of *Schoenoplectus hallii* and *S. saximontanus*. Species specific markers were consistent in *S. hallii* plants examined from Missouri and Illinois and other populations in WMWR where the hybrids have not yet been documented. The species specific markers were also consistent in all *S. saximontanus* plants examined from a population in Texas and a non-hybrid site in WMWR.

Young's (2002) AFLP marker results indicated that *Schoenoplectus hallii* and *S. saximontanus* are distinct with species specific markers. Our ISSR marker data are consistent with this result. Based on the presence of unique species markers (Table 2) and the higher within population similarity values compared to the between species comparisons (Table 3), these taxa are distinct and not exhibiting introgression or extensive gene flow.

### Support for hybridization

Young (2002) found no evidence for hybridization between sympatric populations of *Schoenoplectus hallii* and *S. saximontanus* on the WMWR. In contrast, our results confirm the initial suppositions of hybridization between *S. hallii* and *S. saximontanus* on the WMWR and FSMR based on morphological observations as reported by Smith et al. (2004), McKenzie et al. (2007) and Smith and McKenzie (2011). Plants previously identified by morphological characters as hybrids from both sites contained combinations of 9 species marker bands from *S. hallii* and 6 species marker bands from *S. saximontanus* (Table 2).

We did not find complete additivity in any of the hybrids. This was expected because we do not know what generations of hybrids were involved. They are most likely later generations than an F1 because the parents are now absent from some sites and the species is an annual. The inability to detect either parent during the 2010 visit strongly suggests that backcrossing and F2 generation plants were involved.

In the comparisons among taxa, the hybrids do not appear to be consistently more similar to one parent over the other (Table 3). The WMWR hybrids appear to be more similar to *Schoenoplectus saximontanus* from the site and the FSMR plants appear to be more similar to *S. hallii* collected from WMWR. More genetic similarities with one parent versus the other may reflect differences in abundance of *S. hallii* and *S. saximontanus* at the different study sites. There were no parental plants observed at the FSMR in 2010, so genetic comparisons with parents from that site are currently not possible.

Although *Schoenoplectus hallii* and *S. saximontanus* are currently distinct species, hybridization at the WMWR and FSMR in Oklahoma may threaten their existence at these sites. As reported by Smith and McKenzie (2011), no parental species were found at the FSMR site in 2010 where parents and hybrids were abundant in 2009. They also reported declines of both parental species at the WMWR site since 2007, and in 2010, *S. saximontanus* was absent from the site. The decline in the parental taxa and the increasing number of hybrids, and areas with them, suggest that the hybrids likely outcompete either of the parental species. If mixing of the two parental species continue, eventually it is possible that only the hybrids will occur on the WMWR and FSMR and other areas in the USA where *S. hallii* and *S. saximontanus* are now sympatric.

Why the number of hybrids is apparently increasing is unknown. Although the chromosome numbers (*Schoenoplectus hallii*  $n=11$ , *S. saximontanus*  $n=25$ ) of the parental taxa differ, and many hybrid achenes examined during observations made between 2001 and 2010 appeared to be abortive (Smith et al. 2004; Smith & McKenzie 2011), viable seed was produced by others (Smith et al. 2004). Arnold et al. (2011) hypothesized that despite the low fertility of hybrid species, they are still able to produce viable gametes for successive generations. Despite the lack of information on the chromosome numbers of *S. hallii* x *S. saximontanus* hybrids, it is possible that changes in chromosome number or chromosomal substitutions or rearrangements could result in the increased fertility and success of these plants over time (Chester et al. 2012; Soltis & Soltis 2000). Future work should include examination of seed set and chromosome numbers of the hybrids. This information may provide insight as to why the hybrids are increasing in number and displacing the parents at some locations.

There are additional records of possible hybrids between closely related congeners of the *Supini* group of *Schoenoplectus* species. Galen Smith (2002) reported a suspected cross between *Schoenoplectus hallii* and *S. erectus* in Georgia where the two species are sympatric. There is a second specimen of *S. saximontanus* from Texas (Lundell and Lundell 1075, housed at MICH with a duplicate at BRIT) that is likely a hybrid between *S. hallii* and *S. erectus* (Poirot) Palla ex J. Raynal subsp. *raynalianus* (Schuyler) Lye. The duplicate was annotated initially by A. E. Schuyler as a hybrid between *S. bergonsii* Schuyler (now *S. saximontanus*) and *S. wilkenii* Schuyler (now *S. erectus*). It was subsequently annotated by Galen Smith as *S. saximontanus* in 1993 as an atypical specimen of *S. saximontanus*, but with abortive and immature achenes (pers. comm. 2010). Dr. Anton Reznicek of the University of Michigan Herbarium compared the specimen with a duplicate of a hybrid collection of *S. hallii* x *S. saximontanus* (McKenzie 2317) and agreed that the Lundell and Lundell collection was of hybrid origin (pers. comm. 2010). Given that *S. hallii* is not known from the location, but *S. saximontanus* and *S. erectus* are, it is likely that hybridization involved these two species. Hybridization is also possible at two sites where *S. saximontanus* and *S. hallii* co-occur (Harper Co., Kansas, Freeman, pers. comm. 2005; and Wise Co., Texas, O'Kennon, pers. comm. 2004). Both *Schoenoplectus hallii* and *S. saximontanus* have been reported in Missouri and Nebraska, but the ranges of the two species currently do not overlap. Nonetheless, migrating waterfowl could bring both species in contact with one another at a future date.

There is possible evidence that hybridization between the two species near Lawton, Oklahoma, may be of recent origin and that hybrid plants may be gradually eliminating both parents. Although putative hybrids were discovered at the WMWR in 2002 (Smith et al. 2004), Smith and McKenzie examined many of the specimens collected by Larry Magrath on the WMWR in 2000 (Magrath 2002) and did not discover any evidence of hybridization. This was somewhat surprising because Magrath collected both species at some of the same sites visited by Smith and McKenzie in 2001 and 2002; however, not all of Magrath's 2000 collections were available, so it is possible that hybrid individuals were present in others that were not examined.

#### Possible impact of hybridization on conservation efforts and future research needs

According to conservation geneticists, potential effects of hybridization are numerous and pose a serious threat to the survival of a rare species that hybridizes with a closely related congener (Levin et al. 1996). Such may be the case in the interaction of the two species considered here.

The confirmation of hybridization between *Schoenoplectus hallii* and *S. saximontanus* at the WMWR and adjacent areas of the FSMR indicates that there is a threat to the persistence of *S. hallii* in Oklahoma, and possibly the overall population status of the species in North America. Documentation of hybridization between species of *Schoenoplectus* within sect. *Supini* strongly suggests that the genetic integrity of all members of this group could be compromised wherever

sympatry occurs. Because waterfowl are very likely dispersal agents, there are few control measures practical or feasible that could be implemented to prevent such interactions. Nonetheless, monitoring of extant populations should be undertaken to assess changes in population status of each species.

Although the extinction of rare species typically is attributed to systematic environmental change that renders the habitat unsuitable (Harrison 1991; National Research Council 1995), hybridization may have a profound effect on the persistence of a species (Rieseberg 1991; Ellstrand 1992; Levin 2002; Rieseberg & Linder 1999). Wolf et al. (2001) noted that hybridization could result in extinction of rare plant species in five or fewer generations, and they viewed hybridization as perhaps the most rapidly acting genetic threat to endangered species.

Hybridization may reduce a population's growth rate by adversely affecting its reproductive effectiveness, its competitive status, and its interactions with herbivores (Levin et al. 1996). The numerical disadvantage of a rare species is compounded by the proliferation of fertile hybrids. The addition of these plants to a population containing two related plants decreases the proportional representation of the rare species. In time, this backcrossing can result in the assimilation of the rare species whose genetic identity will become extinct (Rhymer & Simberloff 1996). We see evidence of these processes in the interaction between *Schoenoplectus hallii* and *S. saximontanus*.

Additional surveys of *Schoenoplectus hallii* and *S. saximontanus* in Kansas and Texas where the two species are sympatric are warranted. Because *S. saximontanus* and *S. erectus* are sympatric in some areas of southern Texas, possible hybridization should be evaluated, especially at sites where both species have been documented. Genetic analyses of *S. erectus* subsp. *raynallii* are needed because there is some possibility that the species may be of hybrid origin. We have observed achenes of *S. hallii* x *S. saximontanus* hybrids that are similar in shape to those described by Smith (2002) for *S. erectus* subsp. *raynallii*, and variations in achenes of *S. erectus* contributed to the description of two species that are now synonymous with *S. erectus* (i.e. *S. wilkensis* and *S. erismanae* Schuyler). The same is the case for *S. bergonsii* that is now placed in synonym with *S. saximontanus*. In addition, the reproductive potential of *S. hallii* x *S. saximontanus* hybrids, estimates of pollen viability, seed set and ploidy level should be investigated.

#### ACKNOWLEDGEMENTS

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## AN OUTLINE OF A CLASSIFICATION SCHEME FOR EXTANT FLOWERING PLANTS

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### ABSTRACT

An outline of a linear arrangement for the flowering plants (Magnoliidae) is presented complete with full bibliographic citations and synonymy at and above the rank of family. It is a slight modification of the system established by the Angiosperm Phylogeny Group, with an expanded number of families, orders and superorders compared to that 2009 system. In addition, subfamilies, tribes, and in some cases subtribes, with bibliographic information, are provided as well. A total of 501 families are recognized and arranged in 92 orders and 20 superorders. The following new names are proposed: Abolbodoideae Suess. & Beyerle ex Thorne & Reveal, Aeonieae Thiede ex Reveal, Alonsoineae Reveal, Anacolosioideae Sleumer ex Reveal, Anemarrheneae Reveal, Anopteroideae Reveal, Azorelleae Reveal, Behnieae Reveal, Bersamoideae Reveal, Bhesoideae Reveal, Calochortoideae Thorne & Reveal ex Reveal, Canacomyriceae Reveal, Canarininae Eddie ex Reveal, Capuroniantheae Mabberley ex Reveal, Carnarvonieae Reveal, Castillejeae Reveal, Centroplacodeae Reveal, Coleae Bojer ex Reveal, Croomieae Reveal, Delavayae Reveal, Dicerocaryae Reveal, Duckeodendroideae Reveal, Epithemateae Reveal, Eriospermoideae Reveal, Hemimeridinae Reveal, Hemimeridoideae Reveal, Hugonioideae Mabberley ex Reveal, Hypodaphnoideae Kostermans ex Reveal, Iochrominae Reveal, Jaborosinae Reveal, Kaliphoreae Reveal, Kanieae Peter G. Wilson ex Reveal, Kirengeshominae Reveal, Laxmannioideae Thorne & Reveal ex Reveal, Linconieae Reveal, Lindleyinae Reveal, Lophopetalae Loes. ex Reveal, Macaranginae G.L. Webster ex Reveal, Mareyinae Radcl.-Sm. ex Reveal, Muntingioideae Reveal, Neuracanthae Reveal, Ondineinae Reveal, Oroxyleae A.H. Gentry ex Reveal & L.G. Lohmann, Oxydendreae Cox ex Reveal, Pachysandreae Reveal, Pachystromateae Reveal, Pentastemonoideae Reveal, Phaceliinae Reveal, Philadelphinae Reveal, Physalidinae Reveal, Prionieae Reveal, Prockioideae Reveal, Pycnocomeae Hutch. ex Reveal, Quivisiantheae Reveal, Romanzoffiinae Reveal, Salpichroinae Reveal, Sarumeae O.C. Schmidt ex Reveal, Schwenckioideae Reveal, Spiraeanthemoideae Reveal, Stemodiaceae Reveal, Stenomeridoideae Reveal, Streptopoideae Mabberley ex Reveal, Suregadae Reveal, Takhtajanieae Takht. ex Reveal, Tasmannieae Takht. ex Reveal, Tepuianthoideae Reveal, Tetrameranthae Reveal, Tovomitae Mabberley ex Reveal, Tribuloidae D.M. Porter ex Reveal, Triosteae Reveal, Triplotegioideae Reveal, Whitfieldieae Bremck. ex Reveal, Witheringiinae Reveal, and Xanthosieae Reveal.

**KEY WORDS:** Angiosperm classification; Magnoliidae

In September of 2009 the Angiosperm Phylogeny Group (APG) published its system of classification, being the seventh to have been released over a three-year period (Heywood et al. 2007; Thorne & Reveal 2007; Mabberley 2008; Takhtajan 2009; APG III, 2009) with the online systems of Shipunov (2012, Version 5.6) and Stevens (2001, onward, 20 Apr 2012) being continuously updated. A summary of these systems was presented by Reveal (2011) where a brief, personal outline of how the angiosperms might be arranged was presented as the last of the above-cited classification schemes. Here that system is broadened with names at the ranks of subfamily, tribe and, in a few instances, names even at the rank of subtribe, although at this time full synonymy is not indicated. Following the outline of the proposed system with full citation and synonymy (p. 2) is a summary arrangement of the system composed only of names and authors (p. 98).

Comments on and an indication of taxa recognized by other authors, but not accepted here, are provided in a section entitled Notes and Comments (p. 152). A few names adopted by Mabberley (2007) and by Takhtajan (2009), but not validly published by them, are validated here to provide these names for those who might wish to use them. A change to the rules of nomenclature mandating that infrafamilial names of conserved family names have priority over names of non-conserved family names resulted in the validation of several new names and the replacement of some long-established names (Reveal 2012). An index to all fully cited names is also provided (p. 168). The 73 new names proposed here are validated on pages 215–220.

In their classification of land plants, Chase and Reveal (2009) recognized 14 subclasses within *Equisetopsida* Eaton. This is now slightly revised with *Psilotidae* Reveal assigned to *Ophioglossidae* Klinge for a total of 13 subclasses of land plants (Reveal & Chase 2010).

Validly published names for angiosperms at the ranks of class and above are summarized by Thorne and Reveal (2007) should one disagree with the view suggested by Chase and Reveal (2009) that the highest rank for the angiosperms is that of subclass. A published summary of all validly published names based on a generic name at and above the rank of family with full citation and type information is also available (Reveal 2010). That published listing is continually updated online at: <http://www.plantsystematics.org/reveal/pbio/fam/allspgnames.html>.

#### AN OUTLINE OF A SYSTEM OF CLASSIFICATION FOR THE ANGIOSPERMS

- XIII. Magnoliidae** Novák ex Takht., *Sist. Filog. Cvetk. Rast.*: 51. 4 Feb 1967  
*Alismatidae* Takht., *Sist. Filog. Cvetk. Rast.*: 461. 4 Feb 1967  
*Arecidae* Takht., *Sist. Filog. Cvetk. Rast.*: 525. 4 Feb 1967  
*Aridae* Takht., *Divers. Classif. Fl. Pl.*: 579. 24 Apr 1997  
*Asteridae* Takht., *Sist. Filog. Cvetk. Rast.*: 405. 4 Feb 1967  
*Bromeliidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 299. 2002  
*Burmanniidae* Heintze, *Cormofyt. Fylog.*: 10. 1 Jun 1927  
*Calycanthidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 292. 2002  
*Caryophyllidae* Takht., *Sist. Filog. Cvetk. Rast.*: 144. 4 Feb 1967  
*Ceratophyllidae* Doweld, *Tent. Syst. Pl. Vasc.*: xxv. 23 Dec 2001  
*Chloranthidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 292. 2002  
*Commelinidae* Takht., *Sist. Filog. Cvetk. Rast.*: 171. 4 Feb 1967  
*Cornidae* Frohne & U. Jensen ex Reveal, *Phytologia* 76: 4. 2 Mai 1994  
*Dilleniidae* Takht. ex Reveal & Takht., *Phytologia* 74: 171. 25 Mar 1993  
*Ericidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 308. 2002  
*Hamamelididae* Takht., *Sist. Filog. Cvetk. Rast.*: 461. 4 Feb 1967  
*Illiciidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 291. 2002  
*Juncidae* Doweld, *Tent. Syst. Pl. Vasc.*: lxii. 23 Dec 2001  
*Lamiidae* Takht. ex Reveal, *Phytologia* 74: 178. 25 Mar 1993  
*Lauridae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 292. 2002  
*Liliidae* J.H. Schaffn., *Ohio Naturalist* 11: 413. Dec 1911  
*Loranthidae* Tiegh., *Just's Bot. Jahresber.* 24(2): 319. 1898  
*Malvidae* C.Y. Wu ex Thorne & Reveal, *Bot. Rev. (Lancaster)* 73: 111. 29 Jun 2007  
*Myrtidae* J.H. Schaffn., *Ohio Naturalist* 11: 416. Dec 1911  
*Nelumbonidae* Takht., *Divers. Classif. Fl. Pl.*: 83. 24 Apr 1997  
*Nymphaeidae* J.W. Walker ex Takht., *Divers. Classif. Fl. Pl.*: 74. 24 Apr 1997  
*Orchididae* Heintze, *Cormofyt. Fylog.*: 10. 1 Jun 1927  
*Piperidae* Reveal, *Phytologia* 76: 3. 2 Mai 1994

- Plumbaginidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 291. 2002  
*Polygonidae* C.Y. Wu et al., *Acta Phytotax. Sin.* 40: 294. 2002  
*Ranunculidae* Takht. ex Reveal, *Novon* 2: 235. 13 Oct 1992  
*Rosidae* Takht., *Sist. Filog. Cvetk. Rast.*: 264. 4 Feb 1967  
*Rutidae* Doweld, *Tent. Syst. Pl. Vasc.*: xxxiii. 23 Dec 2001  
*Theidae* Doweld, *Tent. Syst. Pl. Vasc.*: xliii. 23 Dec 2001  
*Trurididae* Takht. ex Reveal, *Novon* 2: 235. 13 Oct 1992  
*Winteridae* Doweld, *Tent. Syst. Pl. Vasc.*: xxxiii. 23 Dec 2001  
*Zingiberidae* Cronquist, *Brittonia* 30: 505. 19 Dec 1978
- A. **Amborellanae** M.W. Chase & Reveal, *Bot. J. Linn. Soc.* 161: 123. 28 Oct 2009
1. AMBORELLALES Melikyan, A.V. Bobrov & Zaytzeva in F. Manitz & F.H. Hellwig, *14 Symp. Biodiv. Evolutionsbiol.*: 122. 1 Sep 1999
    1. **Amborellaceae** Pichon, *Bull. Mus. Hist. Nat. (Paris)*, ser. 2, 20: 384. 25 Oct 1948, *nom. cons.*
- B. **Nymphaeanae** Thorne ex Reveal, *Novon* 2: 236. 13 Oct 1992
- Hydatellanae* Takht. ex Reveal, *Novon* 2: 236. 13 Oct 1992
2. NYMPHAEALES Salisb. ex Bercht. & J. Presl, *Pfir. Rostlin*: 270. Jan–Apr 1820
 

*Barclayales* Doweld, *Tent. Syst. Pl. Vasc.*: xxiii. 23 Dec 2001  
*Cabombales* Mart., *Consp. Regn. Veg.*: 38. Sep–Oct 1835  
*Euryalales* H.L. Li, *Amer. Midl. Naturalist* 54: 39. 27 Aug 1955  
*Hydatellales* Cronquist in A.L. Takhtajan, *Bot. Rev. (Lancaster)* 46: 317. 1980  
*Hydropeltidales* Spenn., *Handb. Angew. Bot.* 1: 202. 1–19 Jul 1834
  2. **Hydatellaceae** U. Hamann, *New Zealand J. Bot.* 14: 195. 22 Jun 1976
  3. **Cabombaceae** Rich. ex A. Rich. in J.B.G.M. Bory de Saint-Vincent, *Dict. Class. Hist. Nat.* 2: 608. 31 Dec 1822, *nom. cons.*

*Hydropeltidaceae* Dumort., *Comment. Bot.*: 64. Nov–Dec 1822

    - a. **Hydropeltioideae** Eaton, *Bot. Dict.*, ed. 4: 37. Apr–Mai 1836
    - b. **Cabomboideae** Burnett, *Outlines Bot.*: 842, 1093, 1122. Feb 1835
  4. **Nymphaeaceae** Salisb., *Ann. Bot. (König & Sims)* 2: 70. Jun 1805, *nom. cons.*

*Barclayaceae* H.L. Li, *Amer. Midl. Naturalist* 54: 40. 27 Aug 1955  
*Euryalaceae* J. Agardh, *Theoria Syst. Pl.*: 51. Apr–Sep 1858  
*Nupharaceae* A. Kern., *Pflanzenleben* 2: 699. 6–13 Jun 1891

    - a. **Nupharoideae** M. Ito, *Bot. Mag. (Tokyo)* 100: 33. 1987
    - b. **Nymphaeoidae** Arn., *Botany*: 96. 9 Mar 1832
      - b1. **Cabombeae** Gardner, *Icon. Pl.*, ser. 2, 7: ad t. 641. 1844
      - b2. **Nymphaeae** DC., *Syst. Nat.* 2: 43, 48. late Mai 1821
        - b2a. **Nymphaeinae** Engl., *Syllabus*, ed. 5: 125. 20–22 Jul 1907
        - b2b. **Ondineinae** Reveal, *Phytoneuron* 2012-37: 218. 23 Apr 2012
      - b3. **Euryaleae** Endl., *Gen. Pl.*: 899. Nov 1839
- C. **Austrobaileyanae** M.W. Chase & Reveal, *Bot. J. Linn. Soc.* 161: 123. 28 Oct 2009
- Chloranthanae* Doweld, *Tent. Syst. Pl. Vasc.*: xxiv. 23 Dec 2001  
*Illicinae* Doweld, *Tent. Syst. Pl. Vasc.*: xxiii. 23 Dec 2001  
*Trimenianae* Doweld, *Tent. Syst. Pl. Vasc.*: xxiii. 23 Dec 2001
3. AUSTROBAILEYALES Takht. ex Reveal, *Novon* 2: 238. 13 Oct 1992
 

*Illiciales* Hu ex Cronquist, *Integr. Syst. Class. Fl. Pl.*: 94. 10 Aug 1981  
*Schisandrales* Mart., *Consp. Regn. Veg.*: 39. Sep–Oct 1835  
*Trimeniales* Doweld, *Byull. Mosk. Obshch. Ispyt. Prir.*, *Biol.* 105(5): 60. 9 Oct 2000
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  - Sanguisorbales* Link, *Handbuch* 2: 113. 4–11 Jul 1829
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    - a3. **Boehmerieae** Gaudich. in H.L.C. de Saules de Freycinet, *Voy. Uranie, Bot.*: 499. 6 Mar 1830
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  - b. **Canacomyriceae** Reveal, *Phytoneuron* 2012-37: 216. 23 Apr 2012
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  - a2. **Elaeocarpeae** Bartl., *Ord. Nat. Pl.*: 340. Sep 1830
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- 55. **VIOLALES** Vent. ex Bercht. & J. Presl, *Pfir. Rostlin.*: 220. Jan–Apr 1820
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  - Passiflorales* Juss. ex Bercht. & J. Presl, *Pfir. Rostlin.*: 237. Jan–Apr 1820
  - Salicales* Lindl., *Nix. Pl.*: 17. 17 Sep 1833
  - Samydales* Vent. ex Bercht. & J. Presl, *Pfir. Rostlin.*: 227. Jan–Apr 1820
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  - Pangiaceae* Hassk., *Cat. Hort. Bot. Bogor.*: 186. Oct 1844
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  - b2. **Leoniaceae** Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 253, Comm. 162. 5–11 Apr 1840

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  - b2. **Ochneae** Bartl., *Ord. Nat. Pl.*: 384. Sep 1830
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  - c1. **Sauvagesieae** Ging. ex DC., *Prodr.* 1: 315. medio Jan 1824
  - c2. **Euthemideae** Benth. & Hook.f., *Gen. Pl.* 1: 317. 7 Aug 1862
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- 225. **Quinaceae** Choisy ex Engl. in C.F.P. von Martius, *Fl. Bras.* 12(1): 475, 476. 1 Apr 1888, *nom. cons.*
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  - Marathrales* Dumort., *Anal. Fam. Pl.*: 60. 1829
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- a. **Clusioideae** Burnett, *Outlines Bot.*: 794. Feb 1835

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- a3. *Tovomitae* Mabblerley ex Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012
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- c. *Lorostemoneae* Ducke, *Arg. Inst. Biol. Veg.* 1: 210. Aug 1935
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  - a3. *Cratoxyleae* Benth. & Hook.f., *Gen. Pl.* 1: 164. 7 Aug 1862
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- b12k. Lasiococcinae G.L. Webster, *Taxon* 24: 597. 19 Dec 1975
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246. **Geraniaceae** Juss., *Gen. Pl.*: 268. 4 Aug 1789, *nom. cons.*  
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247. **Melanthaceae** Horan., *Prim. Lin. Syst. Nat.*: 100. 2 Nov 1834, *nom. cons.*  
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*Combretales* R. Br. ex Bercht. & J. Presl, *Pfir. Rostlin.* 234. Jan–Apr 1820  
*Epilobiales* Mart., *Consp. Regn. Veg.*: 48. Sep–Oct 1835  
*Henslowiales* Mart., *Consp. Regn. Veg.*: 14. Sep–Oct 1835  
*Lythrales* Link, *Handbuch* 2: 47. 4–11 Jul 1829  
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- b2. **Julanieae** Reveal, *Phytoneuron* 2012-33: 2. 9 Apr 2012
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- b5. *Cupanieae* Blume, *Rumphia* 3: 157. Jun 1847
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- b7. *Paullinieae* Kunth ex DC., *Prodr.* 1: 601. medio Jan 1824
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  - a1. **Alstonieae** G. Don, *Gen. Hist.* 4: 70, 86. 1837–8 Apr 1838
  - a2. **Vinceae** Duby, *Bot. Gall.* 1: 324. 12–14 Apr 1828
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  - a6. **Hunterieae** Miers, *Apocyn. S. Amer.*: 6. Mai–Jun 1878
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  - a9. **Alyxieae** G. Don, *Gen. Hist.* 4: 71, 96. 1837–8 Apr 1838
- b. **Apocynoideae** Burnett, *Outlines Bot.*: 1012, 1095, 1104. Feb 1835
  - b1. **Wrightieae** G. Don, *Gen. Hist.* 4: 70, 85. 1837–8 Apr 1838
  - b2. **Malouetieae** Müll.-Arg. in C.F.P. von Martius, *Fl. Bras.* 6(1): 5, 89. 30 Jul 1866
  - b3. **Apocynae** Rehb., *Fl. Germ. Excurs.* 1(3): 410, 429. Jul–Dec 1831
  - b4. **Mesechiteae** Miers, *Apocyn. S. Amer.*: 10. Mai–Jun 1878
  - b5. **Echiteae** Bartl., *Ord. Nat. Pl.*: 204. Sep 1830
- c. **Periplocoideae** Endl., *Gen. Pl.*: 587. Aug 1838
- d. **Secamonoideae** Endl., *Gen. Pl.*: 589. Aug 1838

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  - Echiales* Lindl., *Veg. Kingd.*: 649. 14–28 Mar 1846
  - Ehretiales* Mart., *Consp. Regn. Veg.*: 22. Sep–Oct 1835
  - Hydroleales* Mart., *Consp. Regn. Veg.*: 23. Sep–Oct 1835
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- a2. **Kaliphoreae** Reveal, *Phytoneuron* 2012-37: 217. 23 Apr 2012
- 434. **Sphenocleaceae** T. Baskerv., *Affin. Pl.*: 110. 1839, *nom. cons.*
- 435. **Hydroleaceae** R. Br. ex Edwards, *Bot. Rev. (London)* 7: ad t. 566. 1 Aug 1821
- 436. **Convolvulaceae** Juss., *Gen. Pl.*: 132. 4 Aug 1789, *nom. cons.*
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  - Cuscutaceae* Dumort., *Anal. Fam. Pl.*: 20, 25. 1829, *nom. cons.*
  - Dichondraceae* Dumort., *Anal. Fam. Pl.*: 20, 24. 1829, *nom. cons.*
  - Erycibaceae* Endl. ex Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 272, Comm. 185. 5–11 Apr 1840
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*Browallieaceae* Bercht. & J. Presl, *Pfir. Rostlin*: 243. Jan–Apr 1820  
*Cestraceae* Schldtl., *Linnaea* 8: 250. Jan–Jul 1833  
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- c. **Duckeodendroideae** Reveal, *Phytoneuron* 2012-37: 216. 23 Apr 2012
- d. **Cestroideae** Burnett, *Outlines Bot.*: 985, 1095, 1106. Feb 1835
- d1. **Benthamielleae** Hunz., *Kurtziana* 28: 61. Jul 2000
- d2. **Browallieae** Hunz., *Lorentzia* 8: 6. 31 Mai 1995
- d3. **Cestreae** Dumort., *Anal. Fam. Pl.*: 24. 1829
- d4. **Salpiglossideae** Benth., *Edwards's Bot. Reg.* 21: ad t. 1770. 1 Feb 1835
- e. **Schwenckioideae** Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012
- f. **Petunioideae** Thorne & Reveal, *Bot. Rev. (Lancaster)* 73: 132. 29 Jun 2007
- g. **Nicotianoideae** Miers, *London J. Bot.* 7: 58. 1848
- g1. **Anthocercideae** G. Don, *Gen. Hist.* 4: 399, 478. 1837–8 Apr 1838
- g2. **Nicotianeae** Dumort., *Fl. Belg.*: 38. 1827
- h. **Solanoideae** Burnett, *Outlines Bot.*: 985, 1095, 1106. Feb 1835
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- h2. **Mandragoreae** Rchb., *Handb. Nat. Pfl.-Syst.*: 201. 1–7 Oct 1837
- h3. **Hyoscyameae** Endl., *Gen. Pl.*: 664. Jan 1839
- h3a. **Hyoscyaminae** Kitt. in A. Richard, *Nouv. Elém. Bot.*, ed. 3, Germ. transl.: 796. 1840
- h3b. **Lyciinae** Hogg, *Veg. Kingd.*: 545. 1858
- h3c. **Jaborosinae** Reveal, *Phytoneuron* 2012-37: 217. 23 Apr 2012
- h4. **Nolaneae** Rchb., *Handb. Nat. Pfl.-Syst.*: 200. 1–7 Oct 1837
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- h6. **Datureae** Dumort., *Anal. Fam. Pl.*: 24. 1829
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- h7b. **Physalidinae** Reveal, *Phytoneuron* 2012-37: 218. 23 Apr 2012
- h7c. **Witheringiinae** Reveal, *Phytoneuron* 2012-37: 220. 23 Apr 2012
- h7d. **Salpichroinae** Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012
- h8. **Solaneae** Dumort., *Anal. Fam. Pl.*: 24. 1829
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*Echiaceae* Raf., *Fl. Tellur.* 2: 61. Jan–Mar 1837  
*Ehretiaceae* Mart., *Nov. Gen. Sp. Pl.* 2: 136, 138. Jan–Jun 1827, *nom. cons.*  
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 d1a. **Phaceliinae** Reveal, *Phytoneuron* 2012-37: 218. 23 Apr 2012  
 d1b. **Hydrophyllinae** Reveal, *Phytoneuron* 2012-33: 2. 9 Apr 2012  
 d1c. **Romanzoffiinae** Reveal, *Phytoneuron* 2012-37: 218. 23 Apr 2012
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 g. **Cordioideae** Beilschm., *Flora* 16(Beibl. 7): 69, 106. 14 Jun 1833  
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 g2. **Cordieae** Dumort., *Anal. Fam. Pl.*: 25. 1829
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*Fraxinales* Bercht. & J. Presl, *Pfir. Rostlin*: 224. Jan–Apr 1820  
*Gesneriales* Rich. ex Bercht. & J. Presl, *Pfir. Rostlin*: 252. Jan–Apr 1820  
*Globulariales* Dumort., *Anal. Fam. Pl.*: 19. 1829  
*Hippuridales* Link, *Handbuch* 1: 288. 4–11 Jul 1829  
*Jasminales* R. Br. ex Bercht. & J. Presl, *Pfir. Rostlin*: 248. Jan–Apr 1820  
*Lentibulariales* Rich. ex Bercht. & J. Presl, *Pfir. Rostlin*: 242. Jan–Apr 1820  
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*Oleales* R. Br. ex Bercht. & J. Presl, *Pfir. Rostlin*: 248. Jan–Apr 1820  
*Orobanchales* Vent. ex Bercht. & J. Presl, *Pfir. Rostlin*: 242. Jan–Apr 1820  
*Pedaliales* R. Br. ex Bercht. & J. Presl, *Pfir. Rostlin*: 246. Jan–Apr 1820  
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*Plantaginales* Juss. ex Bercht. & J. Presl, *Pfir. Rostlin*: 241. Jan–Apr 1820  
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*Selagimales* Mart., *Consp. Regn. Veg.*: 19. Sep–Oct 1835  
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*Forestieraceae* Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 345, Comm. 257. 13–15 Feb 1842  
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*Jasminaceae* Juss., *Gen. Pl.*: 104. 4 Aug 1789  
*Ligustraceae* G. Mey., *Chloris Han.*: 245, 254. Jul–Aug 1836  
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  - b2. Coronantheae Fritsch in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3b: 143. Mai 1893
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  - b7. Episcieae Endl., *Gen. Pl.*: 720. Jan 1839
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- 446. **Plantaginaceae** Juss., *Gen. Pl.*: 89. 4 Aug 1789, *nom. cons.*
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  - Littorellaceae* Gray, *Nat. Arr. Brit. Pl.* 2: 290, 294. 10 Jan 1822
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- a3. *Angelonieae* Pennell, *Proc. Acad. Nat. Sci. Philadelphia* 71: 227. 11 Mar 1920
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- a11. *Digitalideae* Dumort., *Anal. Fam. Pl.*: 24. 1829
- a12. *Veroniceae* Duby, *Bot. Gall.* 1: 355. 12–14 Apr 1828
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- a1a. **Alonsoinae** Reveal, *Phytonuron* 2012-37: 215. 23 Apr 2012
- a1b. **Hemimeridineae** Reveal, *Phytonuron* 2012-37: 217. 23 Apr 2012
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- b3. **Leucophylleae** Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 5: 252. Apr 1850
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- c1. **Scrophularieae** Dumort., *Fl. Belg.*: 35. 1827
- c2. **Limoselleae** Dumort., *Fl. Belg.*: 32. 1827
- d. **Buddlejoideae** Engl., *Syllabus*, ed. 1: 157. Apr 1892
- d1. **Teedieae** Benth., *Edwards's Bot. Reg.* 21: ad t. 1770. 1 Feb 1835
- d2. **Buddlejeae** Bartl., *Ord. Nat. Pl.*: 172. Sep 1830
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  - i2. Saturejeae Benth., *Edwards's Bot. Reg.* 15: ad t. 1282. 1 Nov 1829
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    - i7a. Salviinae Endl., *Gen. Pl.*: 614. Aug 1838
    - i7b. Clinopodiinae Dumort., *Fl. Belg.*: 46. 1827
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    - i7d. Melissinae Dumort., *Fl. Belg.*: 47. 1827
  - i8. Ocimeae Dumort., *Anal. Fam. Pl.*: 22. 1829
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  - a2. Mimuleae Dumort., *Anal. Fam. Pl.*: 23. 1829
  - a3. Phrymeae Hogg, *Veg. Kingd.*: 584. 1858
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- 453. **Rehmanniaceae** Reveal, *Kew Bull.* 66: 000. Aug 2011

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- b1. **Gerardiaceae** Benth., *Edwards's Bot. Reg.* 21: ad t. 1770. 1 Jun 1835
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- b4b. **Buchnerinae** Benth. & Hook.f., *Gen. Pl.* 2: 923. 1–16 Mai 1876
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- a8. **Lantaneae** Endl., *Gen. Pl.*: 635. Aug 1838
457. **Pedaliaceae** R. Br., *Prodr.*: 519. 27 Mar 1810, *nom. cons.*  
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- a4. *Bignoniaceae* Dumort., *Anal. Fam. Pl.*: 23. 1829
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  - 118g. Melampodiinae Less., *Linnaea* 5: 149. Jan 1830
  - 118h. Milleriinae Dumort., *Anal. Fam. Pl.*: 31. 1829
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  - 119a. Arnicinae B.G. Baldwin in B.G. Baldwin, B.L. Wessa & J.L. Panero, *Syst. Bot.* 27: 193. 4 Mar 2002
  - 119b. Baeriinae Benth. & Hook.f., *Gen. Pl.* 2: 167, 200. 7–9 Apr 1873
  - 119c. Hulseinae B.G. Baldwin in B.G. Baldwin, B.L. Wessa & J.L. Panero, *Syst. Bot.* 27: 194. 4 Mar 2002
  - 119d. Madiinae Benth. & Hook.f., *Gen. Pl.* 2: 167, 198. 7–9 Apr 1873
  - 119e. Venegasiiinae B.G. Baldwin in B.G. Baldwin, B.L. Wessa & J.L. Panero, *Syst. Bot.* 27: 194. 4 Mar 2002
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  - 120a. Galeaninae Panero & B.G. Baldwin in K. Kubitzki, *Fam. Gen. Vasc. Pl.* 8: 508. 2007
  - 120b. Lycapsinae H. Rob., *Phytologia* 46: 120. 4 Jun 1980
  - 120c. Peritylinae A. Gray, *Syn. Fl. N. Amer.* 1(2): 71. Jul 1884
- 121. Eupatoriaceae Cass., *J. Phys. Chim. Hist. Nat. Arts* 88: 202. Mar 1819
  - 121a. Oaxacaniinae R.M. King & H. Rob., *Phytologia* 46: 449. 12 Sep 1980
  - 121b. Hofmeisteriinae R.M. King & H. Rob., *Phytologia* 46: 449. 12 Sep 1980

- 121c. *Neomirandaceae* R.M. King & H. Rob., *Phytologia* 46: 448. 12 Sep 1980  
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 121q. *Liatridaceae* Dumort., *Anal. Fam. Pl.*: 31. 1829  
 121r. *Praxelaceae* R.M. King & H. Rob., *Phytologia* 46: 448. 12 Sep 1980  
 121s. *Eupatoriaceae* Dumort., *Anal. Fam. Pl.*: 31. 1829  
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     *Tribelales* Doweld, *Tent. Syst. Pl. Vasc.*: li. 23 Dec 2001  
 481. **Escalloniaceae** R. Br. ex Dumort., *Anal. Fam. Pl.*: 35, 37. 1829, *nom. cons.*  
     *Anopteroaceae* Doweld, *Tent. Syst. Pl. Vasc.*: li. 23 Dec 2001  
     *Eremosynaceae* Dandy in J. Hutchinson, *Fam. Fl. Pl.*, ed. 2: 460. 4 Jun 1959  
     *Polyosmaceae* Blume, *Mus. Bot.* 1: 258. 1851  
     *Tribelaceae* Airy Shaw, *Kew Bull.* 18: 269. 8 Dec 1965  
     a. *Anopteroideae* Reveal, *Phytoneuron* 2012-37: 215. 23 Apr 2012  
     b. *Eremosynoidae* Dandy in J. Hutchinson, *Bull. Misc. Inf.* 1927: 108. 12 Apr 1927  
     c. *Tribeloideae* Thorne & Reveal, *Bot. Rev. (Lancaster)* 73: 120. 29 Jun 2007  
     d. *Escallonioidae* Burnett, *Outlines Bot.*: 734, 1132. Feb 1835  
     e. *Polyosmoideae* Le Maout & Decne., *Traité Général Bot.*: 262. Jan–Apr 1868  
 89. **BRUNIALES** Dumort., *Anal. Fam. Pl.*: 34. 1829  
     *Columelliales* Mart., *Consp. Regn. Veg.*: 27. Sep–Oct 1835  
     *Desfontainiales* Takht., *Divers. Classif. Fl. Pl.*: 377. 24 Apr 1997  
 482. **Columelliaceae** D. Don, *Edinburgh New Philos. J.* 6: 46, 49. Oct–Dec 1828, *nom. cons.*  
 483. **Desfontainiaceae** Endl. ex Pfeiff., *Nomencl. Bot.* 1: 1037. 3 Oct 1873, *nom. cons.*  
 484. **Bruniaceae** R. Br. ex DC., *Prodr.* 2: 43. Nov 1825, *nom. cons.*  
     *Berzeliceae* Nakai, *Chosakuronbun Mokuroku [Ord. Fam. Trib. Nov.]*: 241. 20 Jul 1943  
     a1. *Linconieae* Reveal, *Phytoneuron* 2012-37: 217. 23 Apr 2012  
     a2. *Audouinieae* Nied. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 2a: 133. 9 Mar 1891  
     a3. *Brunieae* Rehb., *Fl. Germ. Excurs.* 2(2): 546. 1832  
 90. **APIALES** Nakai, *Hisi-Shokubutsu*: 58. 1930  
     *Amniales* Small, *Fl. S.E. U.S.*: 851. 22 Jul 1903  
     *Araliales* Juss. ex Bercht. & J. Presl, *Pfir. Rostlin*: 258. Jan–Apr 1820  
     *Aralidiales* Takht. ex Reveal, *Novon* 2: 238. 13 Oct 1992  
     *Griselinales* Takht. ex Reveal & Doweld, *Novon* 9: 550. 30 Dec 1999  
     *Hederiales* Link, *Handbuch* 2: 5. 4–11 Jul 1829  
     *Pennantiales* Doweld, *Tent. Syst. Pl. Vasc.*: lii. 23 Dec 2001  
     *Pittosporales* Link, *Handbuch* 2: 222. 4–11 Jul 1829  
     *Torricelliales* Takht. ex Reveal & Doweld, *Novon* 9: 550. 30 Dec 1999



- 90a. **Aralidiineae** Thorne & Reveal, *Bot. Rev. (Lancaster)* 73: 125. 29 Jun 2007
485. **Pennantiaceae** J. Agardh, *Theoria Syst. Pl.*: 301. Apr–Sep 1858
486. **Torricelliaceae** Hu, *Bull. Fan Mem. Inst. Biol., Bot. Ser.* 5: 311. 20 Jul 1934
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488. **Griselinaceae** J.R. Forst. & G. Forst. ex A.Cunn., *Ann. Mag. Nat. Hist.* 3: 261. Dec 1839
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- 90b. **Apiaceae** G.M. Plunkett & Lowry in G.M. Plunkett et al., *S. African J. Bot.* 70: 379. 7 Oct 2004
490. **Araliaceae** Juss., *Gen. Pl.*: 217. 4 Aug 1789, *nom. cons.*  
*Botryodendraceae* J. Agardh, *Theoria Syst. Pl.*: 231. Apr–Sep 1858  
*Hederaceae* Giseke, *Pracl. Ord. Nat. Pl.*: 519. Apr 1792  
*Hydrocotylaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 258. Jan–Apr 1820, *nom. cons.*
- a. **Aralioideae** Eaton, *Bot. Dict.*, ed. 4: 37. Apr–Mai 1836
- a1. **Cussonieae** Seem., *J. Bot.* 6: 163. 1 Jun 1868
- a2. **Meryteae** Viguier, *Bot. Jahrb. Syst.* 40(Litt.): 23. 21 Mai 1907
- a3. **Hedereae** Dumort., *Fl. Belg.*: 83. 1827
- a4. **Aralieae** Rchb., *Fl. Germ. Excurs.* 2(2): 484. 1832
- a5. **Panaceae** Hook.f. in J.E.M. Le Maout & J. Decaisne, *General Syst. Bot.*: 474. 25 Apr 1873
- b. **Hydrocotyloideae** Burmeister, *Handb. Naturgesch.*: 308. 1837
491. **Myodocarpaceae** Doweld, *Tent. Syst. Pl. Vasc.*: lii. 23 Dec 2001
492. **Apiaceae** Lindl., *Nat. Syst. Bot.*, ed. 2: 21. 13 Jun 1836, *nom. cons.*, *alt.*  
*Actinotaceae* Konstant. & Melikjan, *Bot. Zhurn. (Moscow & Leningrad)* 90: 1763. Dec 2005
- Ammiaceae* Bercht. & C. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Angeliceae* Martinov, *Tekhn.-Bot. Slovar.* 29. 3 Aug 1820
- Bupleuraceae* Bercht. & J. Presl, *Pfir. Rostlin.* 258. Jan–Apr 1820
- Caucalidaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Coriandraceae* Burnett, *Outlines Bot.*: 773, 783, 1093, 1128. Feb 1835
- Daucaceae* Martinov, *Tekhn.-Bot. Slovar.* 183. 3 Aug 1820
- Eryngiaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Ferulaceae* Sacc., *Nouvo Giorn. Bot. Ital.* 4: 214. 31 Jul 1872
- Imperatoriaceae* Martinov, *Tekhn.-Bot. Slovar.* 328. 3 Aug 1820
- Lagoecetaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Mackinlayaceae* Doweld, *Tent. Syst. Pl. Vasc.*: lii. 23 Dec 2001
- Pastinacaceae* Martinov, *Tekhn.-Bot. Slovar.* 457. 3 Aug 1820
- Pimpinellaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 258. Jan–Apr 1820
- Saniculaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Scandiacaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Selmaceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Sileraceae* Bercht. & J. Presl, *Pfir. Rostlin.* 259. Jan–Apr 1820
- Smyrniaceae* Burnett, *Outlines Bot.*: 773, 1093, 1128. Feb 1835
- Umbelliferae* Juss., *Gen. Pl.*: 218. 4 Aug 1789, *nom. cons.*
- a. **Mackinlayoideae** G.M. Plunkett & Lowry, *J. S. African Bot.* 70: 379. 7 Oct 2004
- a1. **Mackinlayaceae** Hook.f. in J.E.M. Le Maout & J. Decaisne, *General Syst. Bot.*: 474. 25 Apr 1873
- a2. **Xanthosieae** Reveal, *Phytoneuron* 2012-37: 220. 23 Apr 2012
- a2a. **Xanthosiinae** Tausch, *Flora* 17(1): ad t. 340. 14 Jun 1834

- a2b. Centellinae Calcutt., *Webbia* 1: 101, 117. 10 Mai 1905
- b. Azorelloideae G.M. Plunkett & Lowry, *J. S. African Bot.* 70: 379. 7 Oct 2004
  - b1. Mulineae DC., *Prodr.* 4: 57, 78. late Sep 1830
  - b2. Azorelleae Reveal, *Phytoneuron* 2012-37: 215. 23 Apr 2012
  - b3. Bowlesieae Small, *Man. S.E. Fl.*: 961. 30 Nov 1933
- c. Saniculoideae Burnett, *Outlines Bot.*: 774. Feb 1835
  - c1. Phlyctidocarpeae Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk, *Taxon* 59: 578. 4 Apr 2010
  - c2. Steganotaenieae C.I. Calviño & S.R. Downie, *Molec. Phylog. Evol.* 44: 187. Jul 2007
  - c3. Saniculeae W.D.J. Koch, *Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 12(1): 66, 138. 1824
- d. Apiioideae Seem., *Fl. Vit.*: 112. Jan 1866
  - d1. Lichtensteiniae Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk, *Taxon* 59: 578. 4 Apr 2010
  - d2. Marlothiellae Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk, *Taxon* 59: 578. 4 Apr 2010
  - d3. Choritaenae Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk, *Taxon* 59: 578. 4 Apr 2010
  - d4. Annesorhizeae Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk, *Taxon* 59: 577. 4 Apr 2010
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  - d6. Bupleureae Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xxxiii. Aug-Dec 1820
  - d7. Pleurospermeae M.F. Watson & S.R. Downie, *Amer. J. Bot.* 87: 289. 15 Feb 2000
  - d8. Oenantheae Dumort., *Fl. Belg.*: 79. 1827
  - d9. Smyrniae Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xxxvii. Aug-Dec 1820
  - d10. Aciphyllae M.F. Watson & S.R. Downie, *Amer. J. Bot.* 87: 288. 15 Feb 2000
  - d11. Scandiceae Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xliii. Aug-Dec 1820
    - d11a. Daucinae Dumort., *Fl. Belg.*: 81. 1827
    - d11b. Ferulinae Drude in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 8: 115. Dec 1897
    - d11c. Scandicinae Tausch, *Flora* 17: 342, ad t. 340, 342. 14 Jun 1834
    - d11d. Torilidinae Dumort., *Fl. Belg.*: 81. 1827
  - d12. Careae Baill., *Hist. Pl.* 7: 174, 219. Apr 1879
  - d13. Pyramidopterae Boissier, *Fl. Orient.* 2: 1089. 1872
  - d14. Pimpinellae Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xxxiv. Aug-Dec 1820
  - d15. Echinophoreae Benth. & Hook.f., *Gen. Pl.* 1: 862, 865. Sep 1867
  - d16. Caucalideae Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xl. Aug-Dec 1820
  - d17. Coriandreae W.D.J. Koch, *Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 12(1): 65, 82. 1824
  - d18. Hohenackerieae Calcutt., *Webbia* 1: 102, 133. 10 Mai 1905
  - d19. Apieae Takht. ex V.M. Vinogr., *Fl. Vostochnoi Evropy* 11: 339. 2004
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  - d21. Peucedaneae Dumort., *Fl. Belg.*: 82. 1827

- d22. **Tordylieae** W.D.J. Koch, *Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 12(1): 65, 85. 1824
- d23. **Laserpitieae** Coss. & Germ., *Fl. Desc. Anal. Paris*: 197, 220. 22 Feb 1845
- d24. **Selineae** Spreng. in J.J. Roemer & J.A. Schultes, *Syst. Vég.* 6: xlv. Aug-Dec 1820
91. **PARACRYPHIALES** Takht. ex Reveal, *Novon* 2: 239. 13 Oct 1992
- Quintiniales* Doweld, *Tent. Syst. Pl. Vasc.*: lii. 23 Dec 2001
- Sphenostemonales* Doweld, *Tent. Syst. Pl. Vasc.*: li. 23 Dec 2001
493. **Paracryphiaceae** Airy Shaw, *Kew Bull.* 18: 265. 8 Dec 1965
- Sphenostemonaceae* P. Royen & Airy Shaw, *Kew Bull.* 27: 325. 23 Oct 1972
494. **Quintiniaceae** Doweld, *Tent. Syst. Pl. Vasc.*: lii. 23 Dec 2001
92. **DIPSACALES** Juss. ex Bercht. & J. Presl, *Pfir. Rostlin*: 255. Jan-Apr 1820
- Adoxales* Nakai, *J. Jap. Bot.* 24: 14. Dec 1949
- Caprifoliales* Bercht. & J. Presl, *Pfir. Rostlin*: 257. Jan-Apr 1820
- Lonicerales* T. Liebe, *Grund. Spec. Bot.*: 71. 31 Jan-1 Feb 1866
- Sambuciales* Bercht. & J. Presl, *Pfir. Rostlin*: 258. Jan-Apr 1820
- Valerianales* DC. ex Bercht. & J. Presl, *Pfir. Rostlin*: 256. Jan-Apr 1820
- Viburnales* Dumort., *Anal. Fam. Pl.*: 29. 1829
495. **Adoxaceae** E. Mey., *Preuss. Pfl.-Gatt.*: 198. 1-7 Sep 1839, *nom. cons.*
- Sambucaceae* Batsch ex Borkh., *Bot. Wörterb.* 2: 322. 1797, *nom. cons. prop.*
- Tinaceae* Martinov, *Tekhn.-Bot. Slovar*: 635. 3 Aug 1820.
- Viburnaceae* Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 87. Oct-Dec 1820, *nom. cons. prop.*
- a. **Opuloideae** Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 87. Oct-Dec 1820
- a1. **Viburneae** O.Berg, *Pharm. Bot.*, ed. 5: 305. 1866
- a2. **Sambuceae** A. Rich. ex Duby, *Bot. Gall.* 1: 244. 12-14 Apr 1828
- b. **Adoxoideae** Syme in J.E. Smith & J. Soweby, *Engl. Bot.*, ed. 3(B), 4: 197. 1865
496. **Diervillaceae** Pyck in A. Backlund & N. Pyck, *Taxon* 47: 658. 13 Aug 1998
497. **Caprifoliaceae** Juss., *Gen. Pl.*: 210. 4 Aug 1789, *nom. cons.*
- Loniceraceae* Vest, *Anleit. Stud. Bot.*: 272, 296. 1818
- a1. **Triosteae** Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012
- a2. **Caprifoliaceae** Dumort., *Fl. Belg.*: 55. 1827
498. **Linnaeaceae** Backlund in A. Backlund & N. Pyck, *Taxon* 47: 658. 13 Aug 1998
499. **Morinaceae** Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 88. Oct-Dec 1820
500. **Dipsacaceae** Juss., *Gen. Pl.*: 194. 4 Aug 1789, *nom. cons.*
- Scabiosaceae* Martinov, *Tekhn.-Bot. Slovar*: 563. 3 Aug 1820
501. **Valerianaceae** Batsch, *Tab. Affin. Regni Vég.*: 227. 2 Mai 1802, *nom. cons.*
- Triplostegiaceae* A.E. Bobrov ex Airy Shaw, *Kew Bull.* 18: 269. 8 Dec 1965
- a. **Triplostegioideae** Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012
- b. **Valerianoideae** Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 88. Oct-Dec 1820

## SUMMARY ARRANGEMENT OF MAGNOLIIDAE NOVÁK EX TAKHT.

- A. **Amborellanae** M.W. Chase & Reveal
1. **AMBORELLALES** Melikyan, A.V. Bobrov & Zaytzeva
1. **Amborellaceae** Pichon
- B. **Nymphaeanae** Thorne ex Reveal
2. **NYMPHAEALES** Salisb. ex Bercht. & J. Presl
2. **Hydatellaceae** U. Hamann
3. **Cabombaceae** Rich. ex A. Rich.
- a. **Hydrophelloideae** Eaton

- b. Cabomboideae Burnett
  - 4. **Nymphaeaceae** Salisb.
    - a. Nupharoideae M. Ito
    - b. Nymphaeoidae Arn.
      - b1. Cabombeae Gardner
      - b2. Nymphaeae DC.
        - b2a. Nymphaeinae Engl.
        - b2b. Ondineinae Reveal
      - b3. Euryaleae Endl.
- C. **Austrobaileyanae** M.W. Chase & Reveal
  - 3. AUSTROBAILEYALES Takht. ex Reveal
    - 5. **Austrobaileyaceae** Croizat
    - 6. **Trimeniaceae** Gibbs
    - 7. **Schisandraceae** Blume
    - 8. **Illiciaceae** Bercht. & J. Presl
  - 4. CHLORANTHALES Mart.
    - 9. **Chloranthaceae** R. Br. ex Sims
- D. **Magnolianae** Takht.
  - 5. MAGNOLIALES Juss. ex Bercht. & J. Presl
    - 10. **Myristicaceae** R. Br.
    - 11. **Magnoliaceae** Juss.
      - a. Magnolioideae Arn.
      - b. Liriodendroideae Y.W. Law
    - 12. **Degeneriaceae** I.W. Bailey & A.C. Sm.
    - 13. **Himantandraceae** Diels
    - 14. **Eupomatiaceae** Orb.
    - 15. **Annonaceae** Juss.
      - a. Annonoideae Raf.
      - b. Monodoroideae Hutch.
  - 6. LAURALES Juss. ex Bercht. & J. Presl
    - 6a. Atherospermatineae J. Presl
      - 16. **Calycanthaceae** Lindl.
        - a. Idiospermoideae Thorne
        - b. Calycanthoideae Burnett
    - 17. **Siparunaceae** Schodde
      - a. Siparunoideae Money, I.W. Bailey & Swamy ex Thorne & Reveal
      - b. Glossocalycoideae Thorne ex Philipson
    - 18. **Gomortegaceae** Reiche
    - 19. **Atherospermataceae** R. Br.
      - a1. Atherospermataceae Bartl.
      - a2. Laurelieae Pax
  - 6b. Monimiineae J. Presl
    - 20. **Hernandiaceae** Blume
      - a. Hernandioideae Endl. ex Miq.
      - b. Gyrocarpoideae J. Williams
      - c. Sparattanthelioideae Thorne & Reveal
  - 21. **Monimiaceae** Juss.
    - a. Hortonioidae Thorne & Reveal
    - b. Monimioideae Raf.
      - b1. Palmerieae Philipson
      - b2. Monimieae Rehb.

- b3. *Peumieae* Philipson
  - c. *Mollinedioideae* Thorne
    - c1. *Hedycaryeae* A. DC.
    - c2. *Mollinedieae* Janet R. Perkins
    - c3. *Hennecartieae* Philipson
- 22. **Lauraceae** Juss.
  - a. *Cassythoideae* Burnett
    - a1. *Hypodaphnideae* Kostermans ex Reveal
    - a2. *Cassytheae* Dumort.
    - a3. *Cryptocaryeae* Nees
    - a4. *Perseeae* Nees
  - b. *Lauroideae* Burnett
- 7. CANELLALES Cronquist
  - 23. **Winteraceae** R. Br. ex Lindl.
    - a1. *Takhtajanieae* Takht. ex Reveal
    - a2. *Tasmannieae* Takht. ex Reveal
    - a3. *Wintereae* Meisn.
  - 24. **Canellaceae** Mart.
- 8. PIPERALES Bercht. & J. Presl
  - 25. **Saururaceae** F. Voigt
  - 26. **Piperaceae** Giseke
    - a. *Verhuellioideae* Trel. ex Samain & Wanke
    - b. *Zippelioideae* Samain & Wanke
    - c. *Piperoideae* Arn.
    - d. *Peperomioideae* Miq.
  - 27. **Lactoridaceae** Engl.
  - 28. **Hydnoraceae** C. Agardh
  - 29. **Aristolochiaceae** Juss.
    - a. *Asaroideae* Burnett
      - a1. *Sarumeae* O.C. Schmidt ex Reveal
      - a2. *Asareae* Rchb.
    - b. *Aristolochioideae* Burnett
      - b1. *Apameae* Soler.
      - b2. *Aristolochieae* Dumort. ex Spach
- E. **Lilianaee** Takht.
  - 9. ACORALES Mart.
    - 30. **Acoraceae** Martinov
  - 10. ARALES Juss. ex Bercht. & J. Presl
    - 31. **Araceae** Juss.
      - a. *Gymnostachyoideae* Bogner & Nicolson
      - b. *Orontioideae* R. Br. ex Müll. Berol.
        - b1. *Orontieae* Dumort.
        - b2. *Symplocarpeae* Engl.
      - c. *Lemnoideae* Bab.
      - d. *Pothoideae* Engl.
        - d1. *Anthericeae* Bartl.
        - d2. *Potheae* Bartl.
      - e. *Monsteroideae* Engl.
        - e1. *Heteropsidae* Engl.
        - e2. *Anadendreae* Bogner & J. French
        - e3. *Monstereae* Engl.

- f. **Lasioideae** Engl.
- g. **Zamioculcadoideae** Bogner & Hesse
  - g1. **Stylochaetoneae** Schott
  - g2. **Zamioculcadeae** Schott ex Engl.
- h. **Aroideae** Arn.
  - h1. **Calleae** Bartl.
  - h2. **Philonotieae** S. Y. Wong & P.C. Boyce
  - h3. **Cryptocoryneae** Blume
  - h4. **Schismatoglottideae** Nakai
  - h5. **Anubiadeae** Engl.
  - h6. **Callopsiadeae** Engl.
  - h7. **Culcasieae** Engl.
  - h8. **Montrichardieae** Engl.
  - h9. **Philodendreae** Schott
  - h10. **Homalomenae** M. Hotta
  - h11. **Aglaonemateae** Engl.
  - h12. **Nephtytideae** Engl.
  - h13. **Zantedeschieae** Engl.
  - h14. **Dieffenbachieae** Engl.
  - h15. **Spathicarpeae** Schott
  - h16. **Thomsonieae** Blume
  - h17. **Caladieae** Schott
  - h18. **Ambrosineae** Schott
  - h19. **Arisareae** Dumort.
  - h20. **Peltrandreae** Engl.
  - h21. **Arophyteae** A. Lemee ex Bogner
  - h22. **Protareae** Engl.
  - h23. **Pistieae** Lecoq & Juill.
  - h24. **Colocasieae** Brongn.
  - h25. **Arisaemateae** Nakai
  - h26. **Areae** R. Br. ex Duby
- 11. **TOFIELDIALES** Reveal & Zomlefer
  - 32. **Tofieldiaceae** Takht.
- 12. **ALISMATALES** R. Br. ex Bercht. & J. Presl
  - 33. **Alismataceae** Vent.
  - 34. **Limnocharitaceae** Takht. ex Cronquist
  - 35. **Butomaceae** Mirb.
  - 36. **Hydrocharitaceae** Juss.
    - a. **Hydrocharitoideae** Eaton
    - b. **Stratiotoideae** Luerss.
    - c. **Anacharidoideae** Thomé
    - d. **Najadoideae** Luerss.
      - d1. **Najadeae** Dumort.
      - d2. **Vallisnerieae** Dumort.
      - d3. **Halophileae** Aschers.
- 13. **POTAMOGETONALES** Dumort.
  - 37. **Scheuchzeriaceae** F. Rudolphi
  - 38. **Aponogetonaceae** Planch.
  - 39. **Juncaginaceae** Rich.
    - a. **Juncaginoideae** Arn.
    - b. **Lilaeoideae** Thorne & Reveal

- 40. **Maundiaceae** Nakai
- 41. **Zosteraceae** Dumort.
- 42. **Cymodoceaceae** Vines
- 43. **Zannichelliaceae** Chevall.
- 44. **Potamogetonaceae** Bercht. & J. Presl
- 45. **Posidoniaceae** Vines
- 46. **Ruppiaceae** Horan.
- 14. **PETROSAVIALES** Takht.
  - 47. **Petrosaviaceae** Hutch.
    - a. Japonolirioidae M.N. Tamura
    - b. Petrosavioidae Reveal
- 15. **NARTHECIALES** Reveal & Zomlefer
  - 48. **Nartheciaceae** Fr. ex Bjurzon
- 16. **DIOSCOREALES** Mart.
  - 49. **Taccaceae** Dumort.
  - 50. **Thismiaceae** J. Agardh
  - 51. **Burmanniaceae** Blume
  - 52. **Dioscoreaceae** R. Br.
    - a. Stenomeridoideae Reveal
    - b. Trichopoideae Reveal
    - c. Dioscoreoideae Arn.
- 17. **PANDANALES** R. Br. ex Bercht. & J. Presl
  - 53. **Triuridaceae** Gardner
    - a1. Sciaphileae Hook.f.
    - a2. Triurideae Miers
    - a3. Kupeae Cheek
  - 54. **Velloziaceae** J. Agardh
    - a. Vellozioidae Rendle
    - b. Xerophytoideae Herb.
    - c. Acanthochlamydoideae P.C. Kao
  - 55. **Stemonaceae** Caruel
    - a. Stemonoideae Reveal
      - a1. Stemoneae Voigt
      - a2. Croomieae Reveal
    - b. Pentastemonoideae Reveal
  - 56. **Cyclanthaceae** Poit. ex A. Rich.
    - a. Carludovicoideae Harling
    - b. Cyclanthoideae Burnett
  - 57. **Pandanaceae** R. Br.
    - a. Pandanoideae Burnett
    - b. Freycinetioidae Kurz
- 18. **LILIALES** Perleb
  - 18a. **Campynematineae** Reveal
  - 58. **Corsiaceae** Becc.
  - 59. **Campynemataceae** Dumort.
  - 18b. **Alstroemerineae** J. Presl
  - 60. **Petermanniaceae** Hutch.
  - 61. **Colchicaceae** DC.
    - a. Colchicoideae Burmeister.
      - a1. Burchardiae J.C. Manning & Vinn.
      - a2. Uvulariae A. Gray ex Meisn.

- a3. **Tripladenieae** Vinn. & J.C. Manning
  - b. **Uvularioideae** A. Gray
    - b1. **Colchiceae** T. Nees & C.H. Eberm. ex Endl.
    - b2. **Iphigenieae** Hutch.
    - b3. **Anguillarieae** Pfeiff.
- 62. **Luzuriagaceae** Lotsy
- 63. **Alstroemeriaceae** Dumort.
- 64. **Melanthiaceae** Batsch ex Borkh.
  - a1. **Melanthaceae** Dumort.
  - a2. **Heloniadeae** Fr.
  - a3. **Chionographideae** Nakai
  - a4. **Parideae** Bartl.
  - a5. **Xerophylleae** S. Watson
- 18c. **Smilacineae** Reveal
- 65. **Philesiaceae** Dumort.
- 66. **Rhipogonaceae** Conran & Clifford
- 67. **Smilacaceae** Vent.
- 18d. **Liliineae** Rchb.
- 68. **Liliaceae** Juss.
  - a. **Medeoloideae** M.N. Tamura
  - b. **Lilioideae** Eaton
    - b1. **Tulipeae** Duby
    - b2. **Lilieae** Lam. & DC.
  - c. **Streptopoideae** Mabberley ex Reveal
  - d. **Tricyrtidoideae** Thorne & Reveal
  - e. **Calochortoideae** Thorne & Reveal ex Reveal
- 19. **ORCHIDALES** Raf.
- 69. **Orchidaceae** Juss.
  - a. **Apostasioideae** Horan.
  - b. **Vanilloideae** Szlach.
    - b1. **Pogonieae** Pfitzer ex Garay & Dunsterv.
    - b2. **Vanilleae** Blume
  - c. **Cypripedioideae** Lindl. ex Endl.
  - d. **Limodoroideae** Burnett
    - d1. **Vandae** Lindl.
    - d2. **Neottieae** Lindl.
    - d3. **Epipogoniinae** Parl.
      - d3a. **Nerviliinae** Schltr.
      - d3b. **Epipogoniinae** Schltr.
    - d4. **Triphoreae** Dressler
      - d4a. **Triphorinae** Szlach.
      - d4b. **Diceratostelinae** Szlach.
  - d5. **Tropidieae** Dressler
  - d6. **Sobralieae** Pfitzer
  - d7. **Xerorchideae** P.J. Cribb
  - d8. **Gastrodieae** Lindl.
  - d9. **Arethuseae** Lindl.
    - d9a. **Coelogyminae** Benth.
    - d9b. **Arethusinae** Benth.
  - d10. **Malaxideae** Lindl.
  - d11. **Dendrobieae** Lindl. ex Endl.



- d12. **Maxillarieae** Pfitzer
  - d12a. **Eriopsidinae** Szlach.
  - d12b. **Coeliopsidinae** Szlach.
  - d12c. **Stanhopeinae** Benth.
  - d12d. **Maxillariinae** Benth.
  - d12e. **Oncidiinae** Benth.
  - d12f. **Zygopetalinae** Schltr.
  - d12g. **Vargasiellinae** C. Schweinf. ex G.A. Romero & Carnevali
  - d12h. **Cymbidiinae** Benth.
  - d12i. **Cyrtopodiinae** Benth.
  - d12j. **Catasetinae** Schltr.
  - d12k. **Eulophiinae** Benth.
- d13. **Corallorrhizeae** Fr.
- d14. **Epidendreae** Lindl.
  - d14a. **Coeliinae** Dressler
  - d14b. **Chysidinae** Schltr.
  - d14c. **Ponerinae** Pfitzer
  - d14d. **Bletiinae** Benth.
  - d14e. **Laeliinae** Benth.
  - d14f. **Pleurothallidinae** Lindl. ex G. Don
- d15. **Collabieae** Pfitzer
- d16. **Podochileae** Pfitzer
  - d16a. **Thelasiniae** Ridl.
  - d16b. **Eriinae** Benth.
- f. **Orchidoideae** Eaton
  - f1. **Codonorchideae** P.J. Cribb
  - f2. **Satyrieae** Fr.
    - f2a. **Brownleeinae** H.P. Linder & H. Kurzweil
    - f2b. **Coryciinae** Benth.
    - f2c. **Disinae** Benth.
    - f2d. **Huttonaeinae** Schltr.
    - f2e. **Satyriinae** Pfitzer
  - f3. **Orchideae** Small
    - f3a. **Habenariinae** Benth.
    - f3b. **Orchidinae** Dressler & Dodson ex Reveal
  - f4. **Chloraeaceae** Pfeiff.
  - f5. **Pterostylideae** P. Royen
  - f6. **Cranichideae** Pfeiff.
    - f6a. **Pterostylidinae** Pfitzer
    - f6b. **Physuriniae** Lindl. ex Meisn.
    - f6c. **Galeottellinae** Salazar & M.W. Chase
    - f6d. **Manniellinae** Schltr.
    - f6e. **Cranichidinae** Lindl. ex Meisn.
    - f6f. **Spiranthinae** Lindl. ex Meisn.
    - f6g. **Chloraeinae** Pfitzer
    - f6h. **Achlydosinae** M.A. Clem. & D.L. Jones
  - f7. **Diurideae** Endl. ex Butzin
    - f7a. **Rhizanthellinae** R.S. Rogers
    - f7b. **Prasophyllinae** Schltr.
    - f7c. **Cryptostylidinae** Schltr.
    - f7d. **Drakaeinae** Schltr.

- f7e. *Thelymitrinae* Lindl. ex Meisn.
- f7f. *Megastylidinae* Schltr.
- f7g. *Eriochilinae* M.A. Clem. & D.L. Jones
- f7h. *Spuricianthinae* M.A. Clem. & D.L. Jones
- f7i. *Townsoniinae* M.A. Clem. & D.L. Jones
- f7j. *Acianthinae* Schltr.
- f7k. *Diuridinae* Lindl. ex Meisn.
- f7l. *Adenochilidinae* M.A. Clem. & D.L. Jones
- f7m. *Caladeniinae* Pfitzer
- f7n. *Coilochilideae* M.A. Clem. & D.L. Jones
- 70. **Boryaceae** M.W. Chase, Rudall & Conran
- 71. **Blandfordiaceae** R. Dahlgren & Clifford
- 72. **Lanariaceae** H. Huber ex R. Dahlgren
- 73. **Asteliaceae** Dumort.
- 74. **Hypoxidaceae** R. Br.
- 20. **IRIDALES** Raf.
- 20a. Iridineae Engl.
- 75. **Tecophilaeaceae** Leyb.
  - a. *Wallerioideae* R. Dahlgren
  - b. *Tecophilaeoideae* Reveal
  - c. *Cyanastroideae* Engl. ex Reveal
- 76. **Ixiolirionaceae** Nakai
- 77. **Doryanthaceae** R. Dahlgren & Clifford
- 78. **Iridaceae** Juss.
  - a. *Isophysidoideae* Takht. ex Thorne & Reveal
  - b. *Iridoideae* Eaton
    - b1. *Irideae* Kitt.
    - b2. *Trimezieae* Ravenna
    - b3. *Tigridieae* Kitt.
    - b4. *Sisyrinchieae* Klatt
  - c. *Patersonioideae* Goldblatt
  - d. *Geosiridoideae* Goldblatt & J.C. Manning
  - e. *Aristeoideae* Vines
  - f. *Nivenioideae* Schulze ex Goldblatt
  - g. *Crocoideae* Burnett
    - g1. *Tritoniopsidae* Goldblatt & J.C. Manning
    - g2. *Ixieae* Dumort.
    - g3. *Freeseae* Goldblatt & J.C. Manning
    - g4. *Gladioleae* Dumort.
    - g5. *Watsonieae* Klatt
- 20b. **Asphodelineae** Thorne & Reveal
- 79. **Xeromataceae** M.W. Chase, Rudall & M.F. Fay
- 80. **Hemerocallidaceae** R. Br.
  - a. *Hemerocallidoideae* Lindl.
    - a1. *Phormieae* Nakai
    - a2. *Dianelleae* Baker
    - a3. *Hemerocallideae* Duby
    - a4. *Johnsonieae* Benth.
  - b. *Xanthorrhoeoideae* Reveal
  - c. *Asphodeloideae* Burnett
    - c1. *Asphodeleae* Lam. & DC.

- c1a. **Asphodelinae** Baker
  - c1b. **Kniphofinae** Engl.
  - c2. **Alocae** A. Rich.
- 20c. **Hyacinthineae** Link
  - 81. **Agapanthaceae** F. Voigt
  - 82. **Alliaceae** Borkh.
    - a. **Allioideae** Herb.
    - b. **Tulbaghioidae** M.F. Fay & M.W. Chase
    - c. **Gilliesioideae** Arn.
  - 83. **Amaryllidaceae** J. St.-Hil.
    - a1. **Amaryllideae** Dumort.
    - a2. **Cyrtantheae** Traub
    - a3. **Haemantheae** Hutch.
    - a4. **Calostemmateae** D. Müll.-Doblics & U. Müll.-Doblics
    - a5. **Gethyllideae** Dumort.
    - a6. **Lycorideae** Nakai
    - a7. **Pancratieae** Dumort.
    - a8. **Narcisseae** Lam. & DC.
    - a9. **Galantheae** Parl.
    - a10. **Hippeastreae** Herb. ex Sweet
    - a11. **Eucharideae** Hutch.
    - a12. **Hymenocallideae** Small
    - a13. **Stenomesseae** Traub
    - a14. **Clinantheae** Mesrow
    - a15. **Eustephieae** Hutch.
  - 84. **Hyacinthaceae** Batsch ex Borkh.
    - a. **Oziroëoideae** Speta
    - b. **Urgineoideae** Speta
      - b1. **Oziroëae** M.W. Chase, Reveal & M.F. Fay
      - b2. **Urgineae** Rouy
    - c. **Ornithogaloideae** Speta
      - c1. **Ornithogaleae** Rouy
      - c2. **Dipcadieae** Rouy
    - d. **Hyacinthoideae** Speta
      - d1. **Massonieae** Baker
      - d2. **Hyacintheae** Dumort.
- 85. **Aphyllanthaceae** Burnett
- 86. **Themidaceae** Salisb.
- 87. **Agavaceae** Dumort.
  - a. **Chlorogaloideae** Lotsy
  - b. **Agavoideae** Herb.
    - b1. **Anemarrheneae** Reveal
    - b2. **Agaveae** Dumort.
    - b3. **Behnieae** Reveal
    - b4. **Herrerieae** Baill.
  - c. **Hesperocallidoideae** Thorne & Reveal
  - d. **Anthericoideae** Irvine
- 20d. **Asparagineae** J. Presl
- 88. **Laxmanniaceae** Bubani
  - a. **Lomandroideae** Thorne & Reveal
  - b. **Laxmannioideae** Thorne & Reveal ex Reveal

- 89. **Asparagaceae** Juss.
- 90. **Ruscaceae** M. Roem.
  - a. Eriospermoideae Reveal
  - b. Convallarioideae Herb.
    - b1. Polygonateae Benth. & Hook.f.
    - b2. Convallarieae Dumort.
    - b3. Aspidistreae Endl. ex Meisn.
  - c. Ruscoideae Dippel
  - d. Dracaenoideae Engl.
  - e. Nolinoideae Burnett
- 21. **DASYPOGONALES** Doweld
  - 91. **Dasypogonaceae** Dumort.
    - a. Dasypogonoideae Thorne & Reveal
    - b. Kingioideae Meisn.
- 22. **ARECALES** Bromhead
  - 92. **Areaceae** Bercht. & J. Presl
    - a. Calamoideae Beilschm.
      - a1. Eugeissonae W.J. Baker & J. Dransf.
      - a2. Lepidocaryeae Dumort.
        - a2a. Ancistrophyllinae Becc.
        - a2b. Raphiinae Wendl.
        - a2c. Mauritiinae Meisn.
      - a3. Calameae Lecoq & Juill.
        - a3a. Korthalsiinae Becc.
        - a3b. Salaccinae Becc.
        - a3c. Metroxylinae Blume
        - a3d. Pigafettinae J. Dransf. & N.W. Uhl
        - a3e. Plectocomiinae J. Dransf. & N.W. Uhl
        - a3f. Calaminae Meisn.
    - b. Nypoideae Griff.
    - c. Coryphoideae Burnett
      - c1. Sabaleae Dumort.
      - c2. Cryosophileae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
      - c3. Phoeniceae Horan.
      - c4. Trachycarpeae Satake
        - c4a. Rhapidinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
        - c4b. Livistoninae Saakov
      - c5. Chuniophoeniceae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
      - c6. Caryoteae Scheff.
      - c7. Corypheae Martinov
      - c8. Borasseae Dumort.
        - c8a. Hyphaeninae Becc. ex J. Dransf. & N.W. Uhl
        - c8b. Lataniinae Meisn.
    - d. Ceroxyloideae Drude
      - d1. Cyclospatheae O.F. Cook
      - d2. Ceroxyleae Blatter
      - d3. Phytelphanteae Horan.
    - e. Arecoideae Burnett

- e1. Iriarteae Drude
- e2. Chamaedoreae Drude
- e3. Podococceae J. Dransf. & N.W. Uhl
- e4. Oranieae Becc.
- e5. Sclerospermateae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e6. Roystoneae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e7. Reinhardtiae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e8. Cocoseae Dumort.
  - e8a. Attaleinae Drude
  - e8b. Bactridinae Drude
  - e8c. Elaeidinae Drude
- e9. Manicarieae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e10. Euterpeae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e11. Geonomateae Lucriss.
- e12. Leopoldinieae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e13. Pelagodoxae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- e14. Areceae Dumort.
  - e14a. Archontophoenicinae J. Dransf. & N.W. Uhl
  - e14b. Arcicinae Engl.
  - e14c. Basseliinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
  - e14d. Carpoxylinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
  - e14e. Clinospermatinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
  - e14f. Dypsidinae Becc.
  - e14g. Laccospadicinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
  - e14h. Oncospermatinae Benth. & Hook.f.
  - e14i. Ptychospermatinae Benth. & Hook.f.
  - e14j. Rhopalostylidinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
  - e14k. Verschaffeltinae J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis
- 23. TYPHALES Juss. ex Bercht. & J. Presl
- 93. **Typhaceae** Juss.
  - a. Sparganioideae Rouy
  - b. Typhoideae DC. ex Arn.
- 24. BROMELIALES Link
- 94. **Bromeliaceae** Juss.
  - a. Brocchiniodeae Givnish
  - b. Lindmanioideae Givnish
  - c. Hechtioideae Givnish
  - d. Tillandsioideae Burnett

- d1. Catopsideae Harms
- d2. **Glomeropitcairnieae** Harms
- d3. **Vrieseae** Beer
- d4. **Tillandsiae** Dumort.
- e. **Navioideae** Harms
- f. **Pitcairnioideae** Harms
- g. **Puyoideae** Givnish
- h. **Bromelioideae** Burnett
- 25. **RAPATALES** Colella ex Reveal & Doweld
- 95. **Rapateaceae** Dumort.
  - a. **Rapateoideae** Meisn.
  - b. **Monotremoideae** Givnish & P.E. Berry
  - c. **Saxofridericioideae** Maguire
    - c1. **Saxofridericieae** Maguire
    - c2. **Schoenocephalieae** Maguire
- 26. **XYRIDALES** Lindl.
- 26a. **Eriocaulineae** Thorne & Reveal
- 96. **Eriocaulaceae** Martinov
  - a. **Eriocauloideae** Burnett
  - b. **Paepalanthoideae** Ruhland
- 26b. **Xyridineae** Thorne & Reveal
- 97. **Xyridaceae** C. Agardh
  - a. **Xyridoideae** Kunth ex Arn.
  - b. **Abolbodoideae** Suss. & Beyerle ex Thorne & Reveal
- 98. **Mayacaceae** Kunth
- 27. **JUNCALES** Bercht. & J. Presl
- 99. **Thurniaceae** Engl.
  - a1. **Thurnieae** Reveal
  - a2. **Prionieae** Reveal
- 100. **Juncaceae** Juss.
- 101. **Cyperaceae** Juss.
  - a. **Mapanioideae** C.B. Clarke
    - a1. **Hypolytreae** Nees ex Wight & Arn.
    - a2. **Chrysitricheae** Nees
  - b. **Cyperoideae** Beilschm.
    - b1. **Trilepideae** Goetgh.
    - b2. **Bisboeckelereae** Pax
    - b3. **Sclerieae** Wight & Arn.
    - b4. **Cladieae** Torr.
    - b5. **Cryptangieae** Benth.
    - b6. **Schoeneae** Dumort.
      - b6a. **Schoeniniae** Fenzl
      - b6b. **Rhynchosporinae** Fenzl
    - b7. **Scirpeae** T. Lestib.
    - b8. **Cariceae** Dumort.
    - b9. **Dulichieae** W. Schultze-Motel
    - b10. **Abildgaardieae** Lye
    - b11. **Fuireneae** Fenzl
    - b12. **Eleocharideae** Goetgh.
    - b13. **Cypereae** Dumort.
    - b14. **Ficiniae** Nees

- 28. **RESTIONALES** R. Br. ex Bercht. & J. Presl
  - 102. **Anarthriaceae** D.F. Cutler & Airy Shaw
  - 103. **Hopkinsiaceae** B.G. Briggs & L.A.S. Johnson
  - 104. **Lyginiaceae** B.G. Briggs & L.A.S. Johnson
  - 105. **Centrolepidaceae** Endl.
  - 106. **Restionaceae** R. Br.
    - a. Restionioideae Am.
    - b. Sporadanthoideae B.G. Briggs & H.P. Linder
    - c. Leptocarpoidae B.G. Briggs & H.P. Linder
- 29. **POALES** Small
  - 107. **Flagellariaceae** Dumort.
  - 108. **Joinvilleaceae** Tolm. & A.C. Sm.
  - 109. **Ecdiocolaceae** D.F. Cutler & Airy Shaw
  - 110. **Poaceae** Barnhart
    - a. Anomochloideae Pilg. ex Potztl
      - a1. Streptochaetaeae C.E. Hubb.
      - a2. Anomochloae C.E. Hubb.
    - b. Pharioideae L.G. Clark & Judz.
      - c1. Pueliaeae Soderstr. & R.P. Ellis
      - c2. Guaduelleae Soderstr. & R.P. Ellis
    - d. Panicoideae Link
      - d1. Steyermarkochloae Davidse & R.P. Ellis
      - d2. Hubbardiae C.E. Hubb.
      - d3. Isachneae Benth.
      - d4. Paniceae R. Br.
        - d4a. Arthropogoninae Butzin
        - d4b. Cenchrinae Dumort.
        - d4c. Digitariinae Stapf
        - d4d. Melinidinae Stapf
        - d4e. Panicinae Fr.
        - d4f. Paspalinae Griseb.
        - d4g. Setariinae Dumort.
        - d4h. Neurachninae Clayton & Renvoize
    - d5. Arundinelleae Stapf
    - d6. Andropogoneae Dumort.
      - d6a. Andropogoninae J. Presl
      - d6b. Anthisirinae J. Presl
      - d6c. Coicinae Rehb. ex Clayton & Renvoize
      - d6d. Germainiinae Clayton
      - d6e. Ischaeminae J. Presl
      - d6f. Dimeriinae Hack.
      - d6g. Rottboelliinae J. Presl
      - d6h. Saccharinae Griseb.
      - d6i. Sorghinae Stapf
      - d6j. Tripsacinae Dumort.
    - d7. Gynerieae Sánchez-Ken & L.G. Clark
    - d8. Centothecaeae Ridl.
    - d9. Thysanolaeneae C.E. Hubb.
    - e. Danthonioideae N.P. Barker & H.P. Linder
    - f. Chloridoideae Burmeister.

- f1. *Triraphideae* P.M. Peterson
- f2. *Eragrostideae* Stapf
  - f2a. *Cotteinae* Reeder
  - f2b. *Eragrostidinae* J. Presl
  - f2c. *Uniolinae* Clayton
- f3. *Zoysieae* Benth.
  - f3a. *Zoysiinae* Benth.
  - f3b. *Sporobolinae* Benth.
- f4. *Cynodonteae* Dumort.
  - f4a. *Aeluropodinae* P.M. Peterson
  - f4b. *Triodiinae* Benth.
  - f4c. *Orcuttinae* P.M. Peterson & Columbus
  - f4d. *Gouiniinae* P.M. Peterson & Columbus
  - f4e. *Eleusininae* Dumort.
  - f4f. *Tripogoninae* Stapf
  - f4g. *Pappophorinae* Dumort.
  - f4h. *Traginatae* P.M. Peterson & Columbus
  - f4i. *Hilariinae* P.M. Peterson & Columbus
  - f4j. *Monanthochloinae* Pilg. ex Potztl
  - f4k. *Boutelouinae* Stapf
  - f4l. *Scleropogoninae* Pilg.
  - f4m. *Muhlenbergiinae* Pilg.
- g. *Micrairoideae* Pilg.
  - g1. *Micraireae* Pilg.
  - g2. *Eriachneae* Eck-Boorsb.
- h. *Aristidoideae* Caro
- i. *Arundinoideae* Burmeister.
- j. *Ehrhartoideae* Jacq.-Fél. ex Caro
  - j1. *Ehrharteae* Nevski
  - j2. *Oryzeae* Dumort.
    - j2a. *Luzioliinae* Terrell & H. Rob.
    - j2b. *Oryzinae* Griseb.
    - j2c. *Zizaniinae* Benth.
  - j3. *Streptogyneae* C.E. Hubb. ex Calderón & Soderstr.
- k. *Bambusoideae* Lucriss.
  - k1. *Arundinarieae* Hackel
  - k2. *Olyreae* Kunth ex Spenn.
    - k2a. *Olyrinae* Kromb.
    - k2b. *Parianinae* Hack.
  - k3. *Bambuseae* Kunth ex Dumort.
    - k3a. *Arthrostylydiinae* Soderstr. & R.P. Ellis
    - k3b. *Chusqueinae* Soderstr. & R.P. Ellis
    - k3c. *Guaduinae* Soderstr. & R.P. Ellis
    - k3d. *Bambusinae* J. Presl
    - k3e. *Melocanninae* Benth.
- l. *Pooideae* Benth.
  - l1. *Brachyelytreae* Ohwi
  - l2. *Nardeae* W.D.J. Koch
    - l2a. *Nardinae* Kromb.
    - l2b. *Lygeinae* Röser
  - l3. *Meliceae* Link ex Endl.



- 13a. Brylkininae Ohwi
- 13b. Melicinae Fr.
- 14. Phaenospemateae Renvoize & Clayton
- 15. Stipeae Dumort.
  - 15a. Ampelodesminae Conert
  - 15b. Stipinae Griseb.
- 16. Diarrheneae Tateoka ex C.S. Campb.
- 17. Brachypodieae Harz
- 18. Hordeae Martinov
  - 18a. Littledaleinae Röser
  - 18b. Brominae Dumort.
  - 18c. Hordeinae Dumort.
- 19. Poeae R. Br.
  - 19a. Torreyochloinae Soreng & J.I. Davis
  - 19b. Aveninae J. Presl
  - 19c. Cinninae Caruel
  - 19d. Phalaridinae Fr.
  - 19e. Brizinae Tzvelev
  - 19f. Agrostidinae Fr.
  - 19g. Coleanthinae Rouy
  - 19h. Miborinae Asch. & Graebn.
  - 19i. Scolochloinae Tzvelev
  - 19j. Airinae Fr.
  - 19k. Ammochloinae Tzvelev
  - 19l. Cynosurinae Fr.
  - 19m. Dactylidinae Stapf
  - 19n. Loliinae Dumort.
  - 19o. Parapholiinae Caro
  - 19p. Scribneriinae Soreng & J.I. Davis
  - 19q. Sesleriinae Parl.
  - 19r. Puccinelliinae Soreng & J.I. Davis
  - 19s. Alopecurinae Dumort.
  - 19t. Milinae Dumort.
  - 19u. Poinae Dumort.
- 30. COMMELINALES Mirb. ex Bercht. & J. Presl
  - 30a. Commelinineae Engl.
    - 111. **Commelinaceae** Mirb.
      - a. Cartonematoideae Faden ex G.C. Tucker
        - a1. Cartonemateae Faden & D. Hunt
        - a2. Triceratelleae Faden & D. Hunt
      - b. Commelinoideae Eaton
        - b1. Tradescantieae Meisn.
          - b1a. Palisotinae Faden & D. Hunt
          - b1b. Streptoliriinae Faden & D. Hunt
          - b1c. Cyanotinae Faden & D. Hunt
          - b1d. Coleotrypinae Faden & D. Hunt
          - b1e. Dichorisandrinae Faden & D. Hunt
          - b1f. Thysantheinae Faden & D. Hunt
          - b1g. Tradescantiinae Rohw.
        - b2. Commelineae Dumort.
    - 112. **Hanguanaceae** Airy Shaw

- 30b. **Pontederiaceae** Engl.
- 113. **Philydraceae** Link
- 114. **Haemodoraceae** R. Br.
  - a. **Haemodoroideae** Arn.
  - b. **Conostyloideae** Lindl.
    - b1. **Phlebocaryaceae** Meisn.
    - b2. **Tribonantheae** T.D. Macfarl. & Hopper
    - b3. **Conostylideae** Benth.
- 115. **Pontederiaceae** Kunth
  - a1. **Pontederieae** Dumort.
  - a2. **Heteranthereae** O. Schwartz
- 31. **CANNALES** R. Br. ex Bercht. & J. Presl
  - 31a. **Musineae** W.J. Kress
    - 116. **Musaceae** Juss.
  - 31b. **Heliconiineae** W.J. Kress
    - 117. **Heliconiaceae** Vines
  - 31c. **Strelitziineae** W.J. Kress
    - 118. **Strelitziaceae** Hutch.
      - a1. **Ravenaleae** Voigt
      - a2. **Strelitziaceae** Horan.
  - 31d. **Lowiineae** W.J. Kress
    - 119. **Lowiaceae** Ridl.
  - 31e. **Cannineae** Link
    - 120. **Cannaceae** Juss.
    - 121. **Marantaceae** R. Br.
  - 31f. **Zingiberineae** W.J. Kress
    - 122. **Costaceae** Nakai
    - 123. **Zingiberaceae** Martinov
      - a. **Siphonochiloideae** W.J. Kress
      - b. **Tamijioideae** W. J. Kress
      - c. **Alpinioideae** Hassk.
        - c1. **Alpinieae** Orb.
        - c2. **Riedelieae** W.J. Kress
      - d. **Zingiberoideae** Hassk.
        - d1. **Zingibereae** Meisn.
        - d2. **Globbeae** Meisn.
- F. **Ceratophyllanae** Takht. ex Reveal & Doweld
  - 32. **CERATOPHYLLALES** Link
    - 124. **Ceratophyllaceae** Gray
- G. **Ranunculanae** Takht. ex Reveal
  - 33. **EUPTELEALES** Hu ex Reveal
    - 125. **Eupteleaceae** K. Wilh.
  - 34. **RANUNCULALES** Juss. ex Bercht. & J. Presl
    - 34a. **Ranunculineae** J. Presl
      - 126. **Circaeasteraceae** Hutch.
        - a. **Circaeasteroideae** Thorne & Reveal
        - b. **Kingdonioideae** Thorne & Reveal
      - 127. **Lardizabalaceae** R. Br.
        - a. **Sargentodoxoideae** Thorne & Reveal
        - b. **Lardizabaloideae** Burnett
          - b1. **Decaisneae** Takht. ex H.N. Qin & Y.C. Tang

- b2. Akebieae Lemaire
  - b3. Lardizabaleae DC.
- 128. **Menispermaceae** Juss.
  - a. Tinosporoideae W. Wang & Z.D. Chen
    - a1. Tinosporeae Hook.f. & Thomson
    - a2. Cosciniae Hook.f. & Thomson
  - b. Menispermoideae Arn.
    - b1. Menispermeae DC.
    - b2. Pachygoneae Miers ex Hook.f. & Thomson
    - b3. Anomospermeae Miers
- 129. **Berberidaceae** Juss.
  - a. Podophylloideae Eaton
    - a1. Leonticoideae Nakai
    - a2. Achlydeae Bernh.
    - a3. Podophylleae DC.
  - b. Nandinoideae Heintze
  - c. Berberidoideae Eaton
- 130. **Ranunculaceae** Juss.
  - a. Glaucidoideae Loconte
  - b. Hydrastidoideae Raf.
  - c. Coptidoideae Tamura
    - c1. Coptideae Langlet ex Tamura & K. Kosuge
    - c2. Xanthorhizeae Small
  - d. Thalictroideae Raf.
    - d1. Aquilegieae Arcang.
    - d2. Thalictreae Langlet ex D.Z. Fu
    - d3. Dichocarpeae W.T. Wang & D.Z. Fu
  - e. Ranunculoideae Arn.
    - e1. Actaeae Spach
    - e2. Calthaeae J. Presl
    - e3. Aconiteae Horan.
    - e4. Helleboreae DC.
    - e5. Anemoneae
    - e6. Ranunculeae DC.
- 34b. Papaverineae Thorne & Reveal
- 131. **Pteridophyllaceae** Sugiura ex Nakai
- 132. **Papaveraceae** Juss.
  - a. Papaveroideae Eaton
    - a1. Papavereae Dumort.
    - a2. Romneyeae Benth.
  - b. Eschscholzioidae Luerss.
    - b1. Eschscholzieae Baill.
    - b2. Platystemoneae Spach
  - c. Chelidonioideae W.R. Ernst
    - c1. Chelidonieae Dumort.
    - c2. Bocconieae Bernh.
  - d. Hypecoideae Prantl & Kündig
  - e. Fumarioideae Eaton
    - e1. Fumariae Dumort.
    - e2. Corydaleae Dumort.

## H. **Proteanae** Takht.

- 35. **SABIALES** Takht.
    - 133. **Sabiaceae** Blume
      - a. **Meliosmoideae** Masters
      - b. **Sabioideae** Y.W. Law & Y.F. Wu
  - 36. **PROTEALES** Juss. ex Bercht. & J. Presl
    - 36a. **Nelumbonineae** Shipunov
    - 134. **Nelumbonaceae** A. Rich.
    - 36b. **Platanineae** J. Presl
    - 135. **Platanaceae** T. Lestib.
    - 36c. **Proteineae** Reveal
    - 136. **Proteaceae** Juss.
      - a. **Bellendoideae** P.H. Weston
      - b. **Persoonioideae** Engl.
        - b1. **Placospermeae** C.T. White & W.D. Francis
        - b2. **Persoonieae** Endl.
      - c. **Symphionematoideae** P.H. Weston & N.P. Barker
      - d. **Proteoideae** Eaton
        - d1. **Conospermeae** Endl.
          - d1a. **Stirlingiinae** L.A.S. Johnson & B.G. Briggs
          - d1b. **Conosperminae** L.A.S. Johnson & B.G. Briggs
        - d2. **Petrophileae** P.H. Weston & N.P. Barker
        - d3. **Proteeae** Dumort.
        - d4. **Leucadendreae** P.H. Weston & N.P. Barker
          - d4a. **Isopogoninae** P.H. Weston & N.P. Barker
          - d4b. **Adenanthinae** L.A.S. Johnson & B.G. Briggs
          - d4c. **Leucadendrinae** P.H. Weston & N.P. Barker
      - e. **Sphalmioideae** L.A.S. Johnson & B.G. Briggs
      - f. **Grevilleoideae** Engl.
        - f1. **Carnarvonieae** Reveal
        - f2. **Roupaleae** Meisn.
          - f2a. **Knightiinae** L.A.S. Johnson & B.G. Briggs
          - f2b. **Roupalinae** L.A.S. Johnson & B.G. Briggs
          - f2c. **Lambertiinae** L.A.S. Johnson & B.G. Briggs
          - f2d. **Heliciinae** L.A.S. Johnson & B.G. Briggs
          - f2e. **Floydiinae** L.A.S. Johnson & B.G. Briggs
        - f4. **Banksieae** Dumort.
          - f4a. **Musgraveinae** L.A.S. Johnson & B.G. Briggs
          - f4b. **Banksiinae** L.A.S. Johnson & B.G. Briggs
        - f5. **Grevilleae** Endl.
          - f5a. **Lomatiinae** L.A.S. Johnson & B.G. Briggs
          - f5b. **Embothriinae** Endl.
          - f5c. **Stenocarpinae** L.A.S. Johnson & B.G. Briggs
          - f5d. **Hakeinae** Endl.
      - f6. **Macadamieae** Venkata Rao
        - f6a. **Macadamiinae** L.A.S. Johnson & B.G. Briggs
        - f6b. **Malagasiinae** P.H. Weston & N.P. Barker
        - f6c. **Virotiinae** P.H. Weston & N.P. Barker
        - f6d. **Gevuininae** L.A.S. Johnson & B.G. Briggs
37. **TROCHODENDRALES** Takht. ex Cronquist
  - 137. **Trochodendraceae** Eichler
    - a. **Trochodendroideae** Luerss.

- b. Tetracentroideae Harms
- I. **Buxanae** Takht. ex Reveal & Doweld
  - 38. **BUXALES** Takht. ex Reveal
    - 138. **Haptanthaceae** C. Nelson
    - 139. **Didymelaceae** Leandri
    - 140. **Buxaceae** Dumort.
      - a. Buxoideae Beilschm.
      - b. Pachysandroideae Record & Garratt
        - b1. Stylocerateae Pax
        - b2. Pachysandreae Reveal
- J. **Myrothamnanae** Takht.
  - 39. **GUNNERALES** Takht. ex Reveal
    - 141. **Gunneraceae** Meisn.
    - 142. **Myrothamnaceae** Nied.
- K. **Dilleniaanae** Takht. ex Doweld
  - 40. **DILLENIALES** DC. ex Bercht. & J. Presl
    - 143. **Dilleniaceae** Salisb.
      - a. Delimoideae Burnett
      - b. Doliocarpoidae J.W. Horn
      - c. Hibbertioideae J.W. Horn
      - d. Dillenioideae Burnett
- L. **Saxifraganae** Reveal
  - 41. **PERIDISCALES** Doweld
    - 144. **Peridiscaceae** Kuhlmann
  - 42. **HAMAMELIDALES** Link
    - 42a. Paeoniineae Mart.
    - 145. **Paeoniaceae** Raf.
    - 42b. Hamamelidineae Thorne & Reveal
      - 146. **Altingiaceae** Horan.
      - 147. **Hamamelidaceae** R. Br.
        - a. Exbucklandioideae H.T. Chang
        - b. Disanthoideae Harms
        - c. Hamamelidoideae Burnett
          - c1. Hamamelideae DC.
          - c2. Corylopsideae Harms
          - c3. Eustigmateae Harms
          - c4. Fothergilleae DC.
        - d. Rhodoleioideae Harms
      - 148. **Cercidiphyllaceae** Engl.
      - 149. **Daphniphyllaceae** Müll.-Arg.
  - 43. **SAXIFRAGALES** Bercht. & J. Presl
    - 150. **Crassulaceae** J. St.-Hil.
      - a. Crassuloideae Burnett
        - a1. Umbiliceae Meisn.
        - a2. Semperviveae Dumort.
        - a3. Aeonieae Thiede ex Reveal
        - a4. **Sedae** Fr.
      - b. Kalanchoideae A. Berger
      - c. Sempervivoideae Arn.
    - 151. **Aphanopetalaceae** Doweld

- 152. **Tetracarpaeaceae** Nakai
- 153. **Haloragaceae** R. Br.
  - a1. Myriophylleae Rchb.
  - a2. Halorageae Bartl.
- 154. **Penthoraceae** Rydb. ex Britton
- 155. **Iteaceae** J. Agardh
- 156. **Pterostemonaceae** Small
- 157. **Grossulariaceae** DC.
- 158. **Saxifragaceae** Juss.
  - a. Saxifragoideae Beilschm.
    - a1. Saxifrageae Dumort.
    - a2. Saniculiphyllae C.Y. Wu & T.C. Ku
  - b. Heucheroideae Burnett
    - b1. Chrysosplenieae Dumort.
    - b2. Heuchereae Bartl.
- 44. CYNOMORIALES Burnett
  - 159. **Cynomoriaceae** Endl. ex Lindl.
- M. **Rosanae** Takht.
- 45. VITALES Juss. ex Bercht. & J. Presl
  - 160. **Vitaceae** Juss.
    - a. Vitoideae Eaton
    - b. Leeoideae Burmeister.
- 46. ZYGOPHYLLALES Link
  - 161. **Krameriaceae** Dumort.
  - 162. **Zygophyllaceae** R. Br.
    - a. Morkillioideae Thorne & Reveal
    - b. Balanitoideae Engl.
    - c. Tribuloideae D.M. Porter ex Reveal
      - c1. Sisynditeae Hadidi
      - c2. Neoluederitziae Hadidi
      - c3. Tribuleae Dumort.
    - d. Seetzenioidae Sheahan & M.W. Chase
    - e. Larreoideae Sheahan & M.W. Chase
    - f. Zygophylloideae Arn.
- 47. FABALES Bromhead
  - 163. **Quillajaceae** D. Don
  - 164. **Fabaceae** Lindl.
    - a. Brachystegioideae Hutch.
      - a1. Cercideae Bronn
      - a2. Detarieae DC.
      - a3. Macrobisieae Breteler
    - b. Faboideae Rudd
      - b1. Swartziae DC.
      - b2. Dipterygeae Polhill
      - b3. Sophoreae Spreng. ex DC.
      - b4. Brongniartieae Hutch.
      - b5. Euchrestae H. Ohashi
      - b6. Thermopsidae Yakovlev
      - b7. Podalyrieae Benth.
      - b8. Crotalarieae Hutch.
      - b9. Genisteae Bronn

- b10. **Amorpheae** Boriss.
- b11. **Dalbergieae** DC.
- b12. **Hypocalypteae** A.L. Schutte
- b13. **Mirbelieae** Polhill
- b14. **Bossiaeeae** Hutch.
- b15. **Indigoferaeae** Benth.
- b16. **Millettieae** Miq.
- b17. **Abreae** Hutch.
- b18. **Phaseoleae** DC.
- b19. **Desmodieae** Hutch.
- b20. **Psoraleae** Benth.
- b21. **Sesbanieae** Hutch.
- b22. **Loteae** DC.
- b23. **Robinieae** Hutch.
- b24. **Galegeae** Bronn
- b25. **Hedysareae** DC.
- b26. **Cicereae** Alef.
- b27. **Trifolieae** Endl.
- b28. **Fabeae** Rchb.
- c. **Caesalpinoideae** DC.
  - c1. **Cassieae** Bronn
    - c1a. **Cassiinae** Wight & Arn.
    - c1b. **Storckiiellinae** Nakai
    - c1c. **Duparquetiinae** H.S. Irwin & Barneby
  - c2. **Caesalpinieae** Rchb.
- d. **Mimosoideae** DC.
  - d1. **Mimoseae** Bronn
  - d2. **Parkieae** Endl.
  - d3. **Mimozyantheae** Burkart
  - d4. **Acacieae** Dumort.
  - d5. **Ingeae** Benth. & Hook.f.
- 165. **Surianaceae** Arn.
  - a1. **Rigiostachydeae** Loes. & Solered.
  - a2. **Surianeae** Baill.
  - a3. **Stylobasieae** Bonne
- 166. **Polygalaceae** Hoffmanns. & Link
  - a1. **Xanthophylleae** Baill.
  - a2. **Diclidanthereae** Reveal
  - a3. **Carpolobieae** B. Eriksen
  - a4. **Polygaleae** Fr.
- 48. **ROSALES** Bercht. & J. Presl
- 167. **Rosaceae** Juss.
  - a. **Maloideae** C. Weber
    - a1. **Lyonoathamneae** Brouillet
    - a2. **Neillieae** Maxim.
    - a3. **Amygdaleae** DC.
    - a4. **Exochordeae** Schulze-Mentz ex Reveal
    - a5. **Kerrieae** Focke
    - a6. **Sorbarieae** Rydb.
    - a7. **Spiraeae** DC.
    - a8. **Gillenieae** Maxim.

- a9. **Maleae** Small
  - a9a. **Lindleyinae** Reveal
  - a9b. **Malinae** Reveal
- b. **Rosoideae** Arn.
  - b1. **Ulmarieae** Lam. & DC.
  - b2. **Rubeae** Dumort.
  - b3. **Colurieae** Rydb.
  - b4. **Roseae** Lam. & DC.
  - b5. **Potentilleae** Sweet
    - b5a. **Fragariinae** Torr. & A. Gray
    - b5b. **Alchemillinae** Meisn.
  - b6. **Agrimoniae** Lam. & DC.
    - b6a. **Agrimoniinae** J. Presl
    - b6b. **Sanguisorbinae** Torr. & A. Gray
- c. **Dryadoideae** Sweet
  - c1. **Cercocarpeae** Pfeiff.
  - c2. **Dryadeae** Lam. & DC.
- 49. **RHAMNALES** Link
  - 168. **Barbeyaceae** Rendle
  - 169. **Dirachmaceae** Hutch.
  - 170. **Rhamnaceae** Juss.
    - a. **Rhamnoidae** Eaton
      - a1. **Rhamneae** Horan.
      - a2. **Maesopsidae** Engl. & Weberb.
      - a3. **Ventilagineae** Benth. & Hook.f.
      - a4. **Ampelozizipheae** J.E. Richardson
      - a5. **Doerpfeldiae** J.E. Richardson
      - a6. **Bathiorhamneae** J.E. Richardson
    - b. **Ziziphoideae** Luerss.
      - b1. **Paliureae** Reissek ex Endl.
      - b2. **Colletiae** Reissek ex Endl.
      - b3. **Phyliceae** Reissek ex Endl.
      - b4. **Gouanieae** Rchb.
      - b5. **Pomaderrae** Reissek ex Endl.
  - 171. **Elaeagnaceae** Juss.
- 50. **URTICALES** Juss. ex Bercht. & J. Presl
  - 172. **Ulmaceae** Mirb.
  - 173. **Celtidaceae** Endl.
  - 174. **Cannabaceae** Martinov
  - 175. **Moraceae** Gaudich.
    - a1. **Artocarpeae** Lam. & DC.
    - a2. **Moreae** Dumort.
    - a3. **Maclureae** W.L. Clement & Weiblen
    - a4. **Dorstenieae** Dumort.
    - a5. **Ficeae** Dumort.
    - a6. **Castilleae** C.C. Berg
  - 176. **Urticaceae** Juss.
    - a. **Urticoideae** Arn.
      - a1. **Urticeae** Lam. & DC.
      - a2. **Lecantheae** Wedd.
      - a3. **Boehmerieae** Gaudich.



- a4. Parietarieae Gaudich.
  - a5. Forsskaoleae Gaudich.
  - b. Cecropioideae Romaniuc
- 51. JUGLANDALES Bercht. & J. Presl
- 177. **Nothofagaceae** Kuprian.
- 178. **Fagaceae** Dumort.
  - a. Quercoidae Irvine
  - b. Trigonobalanoideae Lozano
  - c. Castaneoideae Örst.
  - d. Fagoideae K. Koch
- 179. **Myricaceae** Rich. ex Kunth
  - a. Myricae Small
  - b. Canacomyriceae Reveal
- 180. **Juglandaceae** DC. ex Perleb
  - a. Platycaryoideae W.E. Manning
  - b. Engelhardtioideae Iljinsk.
  - c. Juglandoideae Eaton
    - c1. Juglandae Rchb.
    - c2. Caryeae Koidz.
- 181. **Rhoipteleaceae** Hand.-Mazz.
- 182. **Casuarinaceae** R. Br.
- 183. **Ticodendraceae** Gómez-Laur. & L.D. Gómez
- 184. **Betulaceae** Gray
  - a. Betuloideae Rich. ex Arn.
  - b. Coryloideae Hook.f.
    - b1. Carpineae A. DC.
    - b2. Coryleae Dumort.
- 52. CUCURBITALES Juss. ex Bercht. & J. Presl
- 52a. Cucurbitineae J. Presl
- 185. **Anisophylleaceae** Ridl.
- 186. **Corynocarpaceae** Engl.
- 187. **Coriariaceae** DC.
- 188. **Cucurbitaceae** Juss.
  - a1. Gomphogyneae Benth. & Hook.f.
  - a2. Triceratieae A. Rich.
  - a3. Zanonieae Benth. & Hook.f.
  - a4. Actinostemmaeae H. Schaeff. & S.S. Renner
  - a5. Indofevilleae H. Schaeff. & S.S. Renner
  - a6. Thladiantheae H. Schaeff. & S.S. Renner
  - a7. Siraitieae H. Schaeff. & S.S. Renner
  - a8. Momordiceae H. Schaeff. & S.S. Renner
  - a9. Joliffieae Schrad.
  - a10. Bryonieae Dumort.
  - a11. Schizopeponeae C. Jeffrey
  - a12. Sicyoeae Schrad.
  - a13. Coniandreae Endl. ex M. Roem.
  - a14. Benincaseae Scr.
  - a15. Cucurbiteae Dumort.
- 189. **Tetramelaceae** Airy Shaw
- 52b. Begoniineae Engl.
- 190. **Datisceae** Dumort.

- 191. **Begoniaceae** C. Agardh
- 192. **Apodanthaceae** Tiegh. ex Takht.
- 53. **CELASTRALES** Link
  - 193. **Lepidobotryaceae** J. Léonard
  - 194. **Parnassiaceae** Martinov
    - a. Lepuropetaloidae Engl.
    - b. Parnasioideae Arn.
  - 195. **Celastraceae** R. Br.
    - a. Celastroideae Burnett
    - b. Siphonodontoideae Croizat
    - c. Hippocrateoideae Lindl.
    - d. Sarawakodendroideae Savinov & Melikyan
    - e. Salacioideae N. Halle ex Thorne & Reveal
    - f. Stackhousioideae Burnett
  - 196. **Pottingeriaceae** Takht.
- 54. **OXALIDALES** Bercht. & J. Presl
  - 197. **Huaceae** A. Chev.
  - 198. **Connaraceae** R. Br.
    - a. Connaroideae Gilg
    - b. Jollydoroideae Gilg
      - b1. Jollydoreae Lemmens
      - b2. Manoteae Lemmens
      - b3. Cnestideae Planch.
  - 199. **Oxalidaceae** R. Br.
  - 200. **Cunoniaceae** R. Br.
    - a. Spiraeanthemoideae Reveal
    - b. Davidsonioideae Thorne & Reveal
    - c. Baueroideae Burnett
      - c1. Schizomerieae J.C. Bradford & R.W. Barnes
      - c2. Bauereae DC.
    - d. Eucryphioideae Burnett
      - d1. Eucryphiae Cambess. ex G. Don
      - d2. Geissoieae Endl. ex Meisn.
      - d3. Caldcluviae J.C. Bradford & R.W. Barnes
    - e. Cunonioideae Beilschm.
      - e1. Codieae G. Don
      - e2. Cunonieae Schrank & Mart.
  - 201. **Elaeocarpaceae** Juss.
    - a1. Sloanea Endl.
    - a2. Elaeocarpeae Bartl.
  - 202. **Tremandraceae** R. Br. ex DC.
  - 203. **Brunelliaceae** Engl.
  - 204. **Cephalotaceae** Dumort.
- 55. **VIOLALES** Vent. ex Bercht. & J. Presl
  - 205. **Achariaceae** Harms
    - a1. Acharieae Benth. & Hook.f.
    - a2. Kiggelarieae DC.
    - a3. Lindackerieae Zmarzty
    - a4. Erythrospermeae DC.
  - 206. **Goupiaceae** Miers
  - 207. **Violaceae** Batsch

- a. **Fusispermoideae** Hekking
- b. **Violoideae** Beilschm.
  - b1. **Violeae** DC.
  - b2. **Leonieae** Meisn.
- 208. **Turneraceae** Kunth ex DC.
- 209. **Malesherbiaceae** D. Don
- 210. **Passifloraceae** Juss. ex Roussel
  - a1. **Passifloreae** DC.
  - a2. **Paropsieae** DC.
- 211. **Lacistemataceae** Mart.
- 212. **Salicaceae** Mirb.
  - a. **Samydoideae** Reveal
    - a1. **Samydeae** Vent.
    - a2. **Homalieae** Dumort.
    - a3. **Scolopieae** Warb.
    - a4. **Trichostephaneae** Gilg
  - b. **Scyphostegioidae** Reveal
  - c. **Prockioideae** Reveal
    - c1. **Prockieae** Endl.
    - c2. **Abatieae** Benth. & Hook.f.
    - c3. **Bembicieae** Warb.
  - d. **Flacourtioideae** Beilschm.
    - d1. **Flacourtieae** DC.
    - d2. **Oncobeae** Benth.
  - e. **Salicoideae** Rich. ex Arn.
- 56. **RHIZOPHORALES** Pers. ex Bercht. & J. Presl
- 213. **Lophopyxidaceae** H. Pfeiff.
- 214. **Putranjivaceae** Meisn.
- 215. **Ctenolophonaceae** Exell & Mendonça
- 216. **Erythroxylaceae** Kunth
- 217. **Rhizophoraceae** Pers.
  - a. **Cassipoureioideae** Burnett
  - b. **Rhizophoroideae** Burnett
    - b1. **Gynotrocheae** Engl.
    - b2. **Rhizophoreae** Bartl.
- 57. **LINALES** Bercht. & J. Presl
- 218. **Linaceae** DC. ex Perleb
  - a. **Linoideae** Arn.
    - a1. **Lineae** Rchb.
    - a2. **Anisadenieae** H.J.P. Winkl.
  - b. **Hugonioideae** Mabblerley ex Reveal
- 219. **Irvingiaceae** Tiegh.
- 220. **Ixonanthaceae** Planch. ex Miq.
- 221. **Humiriaceae** A. Juss.
- 222. **Pandaceae** Engl. & Gilg
- 58. **OCHNALES** DC. ex Bercht. & J. Presl
- 223. **Ochnaceae** DC.
  - a. **Luxemburgioideae** Planch. ex Endl.
  - b. **Ochnoideae** Burnett
    - b1. **Lophireae** Baill.
    - b2. **Ochneae** Bartl.

- c. Sauvagesioideae Beilschm.
  - c1. Sauvagesieae Ging. ex DC.
  - c2. Euthemieae Benth. & Hook.f.
- 224. **Medusagynaceae** Engl. & Gilg
- 225. **Quinaceae** Choisy ex Engl.
- 59. **HYPERICALES** Juss. ex Bercht. & J. Presl
- 226. **Bonnetiaceae** L. Beauvis. ex Nakai
- 227. **Clusiaceae** Lindl.
  - a. Clusioideae Burnett
    - a1. Garcinieae Choisy
    - a2. Clusieae Choisy
    - a3. Tovomitae Mabberley ex Reveal
  - b. Chrysopioideae Burnett
  - c. Lorostemmonoideae Ducke
- 228. **Calophyllaceae** J. Agardh
  - a1. Kielmeyereae Engl.
  - a2. Calophylleae Choisy
  - a3. Endodesmieae Engl.
  - a4. Caraipeae Engl.
- 229. **Hypericaceae** Juss.
  - a1. Vismieae Choisy
  - a2. Hypericeae Choisy
  - a3. Cratoxyleae Benth. & Hook.f.
- 230. **Podostemaceae** Rich. ex Kunth
  - a. Tristicchioideae Warm.
  - b. Weddellinoideae Engl.
  - c. Podostemoideae Warm.
- 231. **Centroplacaceae** Doweld & Reveal
  - a. Centroplacoideae Reveal
  - b. Bhesoideae Reveal
- 60. **MALPIGHIALES** Juss. ex Bercht. & J. Presl
- 232. **Elatinaceae** Dumort.
- 233. **Malpighiaceae** Juss.
  - a. Byrsonimoideae W.R. Anderson
  - b. Malpighioideae Burnett
    - b1. Tricomarieae Nied.
    - b2. Hiraeae Griseb.
    - b3. Rhynchophoreae Arènes
    - b4. Banisterieae DC.
    - b5. Gaudichaudieae Horan.
- 61. **EUPHORBIALES** Juss. ex Bercht. & J. Presl
- 234. **Peraceae** Klotzsch
  - a1. Clutiae Pax
  - a2. Pogonophoreae G.L. Webster
  - a3. Chaetocarpeae G.L. Webster
  - a4. Pereae Pax & K.Hoffm.
- 235. **Rafflesiaceae** Dumort.
- 236. **Euphorbiaceae** Juss.
  - a. Cheilosoideae K. Wurdack & Petra Hoffm.
    - a1. Cheiloseae Airy Shaw & G.L. Webster
  - b. Acalyphoideae Beilschm.

- b1. *Erismanthaceae* G.L. Webster
- b2. *Ampereae* Müll.-Arg.
- b3. *Agrostistachydeae* G.L. Webster
- b4. *Sphyranthereae* Radcl.-Sm.
- b5. *Chrozophoreae* Pax & K.Hoffm.
  - b5a. *Speranskiinae* G.L. Webster
  - b5b. *Ditaxidinae* Griseb.
  - b5c. *Doryxylinae* G.L. Webster
  - b5d. *Chrozophorinae* Müll.-Arg.
- b6. *Caryodendreae* G.L. Webster
- b7. *Bernardieae* G.L. Webster
- b8. *Pycnocomae* Hutch. ex Reveal
  - b8a. *Pycnocominae* G.L. Webster
  - b8b. *Blumeodendrinae* G.L. Webster
- b9. *Epiprineae* Hurus.
  - b9a. *Epiprininae* Müll.-Arg.
  - b9b. *Cephalomappinae* G.L. Webster
- b10. *Adelieae* G.L. Webster
- b11. *Alchornieae* Hutch.
  - b11a. *Alchorniinae* Hurus.
  - b11b. *Conceveibinae* G.L. Webster
- b12. *Acalypheae* Dumort.
  - b12a. *Ricininae* Griseb.
  - b12b. *Adrianinae* Benth.
  - b12c. *Mercurialinae* Pax
  - b12d. *Cleidiinae* G.L. Webster
  - b12e. *Macaranginae* G.L. Webster ex Reveal
  - b12f. *Claoxylinae* Hurus.
  - b12g. *Lobaniliinae* Radcl.-Sm.
  - b12h. *Mareyinae* Radcl.-Sm. ex Reveal
  - b12i. *Coelodiscinae* Müll.-Arg.
  - b12j. *Acalyphinae* Griseb.
  - b12k. *Lasiococcinae* G.L. Webster
- b13. *Dalechampieae* Müll.-Arg.
  - b13a. *Plukenetiiinae* Benth.
  - b13b. *Tragiinae* G.L. Webster
  - b13c. *Dalechampiinae* G.L. Webster
- b14. *Omphaleae* G.L. Webster
- c. *Crotonoideae* Beilschm.
  - c1. *Micrandreae* G.L. Webster
    - c1a. *Micrandrinae* Müll.-Arg.
    - c1b. *Heveinae* Müll.-Arg.
  - c2. *Manihoteae* Pax
  - c3. *Adenoclineae* G.L. Webster
    - c3a. *Adenoclininae* Müll.-Arg.
    - c3b. *Endosperminae* Pax & K.Hoffm.
  - c4. *Suregadeae* Reveal
  - c5. *Elateriospermeae* G.L. Webster
  - c6. *Jatropheae* Baill.
  - c7. *Codiaeae* Hutch.
  - c8. *Trigonostemoneae* G.L. Webster

- c9. **Ricinocarpeae** Müll.-Arg.
  - c9a. **Ricinocarpinae** G.L. Webster
  - c9b. **Bertyinae** Müll.-Arg.
- c10. **Crotoneae** Dumort.
- c11. **Ricinodendreae** Hutch.
- c12. **Aleuritideae** Hurus.
  - c12a. **Aleuritidineae** G.L. Webster
  - c12b. **Garcinae** Müll.-Arg.
  - c12c. **Grosserinae** G.L. Webster
  - c12d. **Crotonogyninae** G.L. Webster
  - c12e. **Neoboutoninae** G.L. Webster
  - c12f. **Benoistiinae** Radcl.-Sm.
- d. **Euphorbioideae** Beilschm.
  - d1. **Stomatocalyceae** G.L. Webster
    - d1a. **Stomatocalycinae** Müll.-Arg.
    - d1b. **Hamilcoinae** Pax
  - d2. **Hippomaneae** Bartl.
    - d2a. **Carumbiinae** Müll.-Arg.
    - d2b. **Hippomaneinae** Griseb.
  - d3. **Pachystromateae** Reveal
  - d4. **Hureae** Dumort.
  - d5. **Euphorbieae** Dumort.
    - d5a. **Anthosteminae** G.L. Webster
    - d5b. **Neoguillaumininae** Croizat
    - d5c. **Euphorbiinae** Griseb.
- 237. **Phyllanthaceae** Martinov
  - a. **Phyllanthoideae** Beilschm.
    - a1. **Poranthereae** Müll.-Arg. ex Grüning
    - a2. **Brideliaceae** Müll.-Arg.
      - a2a. **Amanoinae** Pax
      - a2b. **Saviinae** Müll.-Arg.
      - a2c. **Keayodendrinae** Petra Hoffm.
      - a2d. **Pseudolachnostylidinae** Pax
      - a2e. **Securineginae** Müll.-Arg.
    - a3. **Wielandieae** Baill. ex Hurus.
      - a3a. **Asterocasiinae** G.L. Webster
      - a3b. **Wielandiinae** Pax
    - a4. **Phyllanthaceae** Dumort.
  - b. **Antidesmatoideae** Hurus.
    - b1. **Antidesmateae** Benth.
      - b1a. **Antidesmatinae** Müll.-Arg.
      - b1b. **Hymenocardiinae** Petra Hoffm.
      - b1c. **Martretziinae** Petra Hoffm.
      - b1d. **Hieronyminae** Müll.-Arg.
      - b1e. **Leptonematinae** Müll.-Arg.
    - b2. **Scepeae** Horan.
    - b3. **Jablonskieae** Petra Hoffm.
    - b4. **Spondiantheae** G.L. Webster
    - b5. **Uapaceae** Hutch.
    - b6. **Bischoffieae** Hurus.
- 238. **Picrodendraceae** Small

- a1. **Podocalyceae** G.L. Webster
  - a1a. **Podocalycinae** G.L. Webster
  - a1b. **Tetracicciniae** G.A. Levin
  - a1c. **Paradrypetinae** G.A. Levin
- a2. **Caletieae** Müll.-Arg.
  - a2a. **Hyaenachinae** Müll.-Arg.
  - a2b. **Dissiliariinae** Pax & K.Hoffm.
  - a2c. **Petalostigmatinae** Pax & K.Hoffm.
  - a2d. **Pseudanthinae** Müll.-Arg.
- a3. **Picrodendreae** Fawc. & Rendle
  - a3a. **Picrodendrinae** G.L. Webster
  - a3b. **Paivaesusinae** Pax
  - a3c. **Mischodontinae** Müll.-Arg.
- 62. **CHRYSOBALANALES** Link
  - 239. **Balanopaceae** Benth. & Hook.f.
  - 240. **Trigoniaceae** A. Juss.
  - 241. **Dichapetalaceae** Baill.
  - 242. **Chrysobalanaceae** R. Br.
    - a1. **Chrysobalaneae** DC.
    - a2. **Parinarieae** Prance & F. White
    - a3. **Couepieae** Prance & F. White
    - a3. **Hirtelleae** Bonne
  - 243. **Euphroniaceae** Marc.-Berti
  - 244. **Caryocaraceae** Voigt
- 63. **GERANIALES** Juss. ex Bercht. & J. Presl
  - 245. **Hypseocharitaceae** Wedd
  - 246. **Geraniaceae** Juss.
  - 247. **Melanthaceae** Horan.
    - a. **Greyioideae** Harv.
    - b. **Melanthoideae** Benth. & Hook.f.
    - c. **Bersamoideae** Reveal
  - 248. **Francoaceae** A. Juss.
  - 249. **Vivianiaceae** Klotzsch
  - 250. **Ledocarpaceae** Meyen
    - a. **Ledocarpoideae** Thorne & Reveal
    - b. **Rhynchothecoideae** Thorne & Reveal
- N. **Myrtanae** Takht.
  - 64. **MYRTALES** Juss. ex Bercht. & J. Presl
    - 64a. **Onagrineae** Rchb.
    - 251. **Combretaceae** R. Br.
      - a. **Strephonematoideae** Engl. & Diels
      - b. **Combretoideae** Beilschm.
        - b1. **Laguncularieae** Engl. & Diels
        - b2. **Combreteae** DC.
    - 252. **Onagraceae** Juss.
      - a. **Ludwigioideae** W.L. Wagner & Hoch
      - b. **Onagroideae** Beilschm.
        - b1. **Hauyeae** Raim.
        - b2. **Circaeae** Dumort.
        - b3. **Lopezieae** Spach
        - b4. **Gongylocarpeae** Donn. Sm. & Rose

- b5. *Epilobieae* Endl.
  - b6. *Onagreae* Dumort.
- 253. **Lythraceae** J. St.-Hil.
  - a. *Lagerstroemioideae* Beilschm.
  - b. *Punicoideae* Lucriss.
  - c. *Lythroideae* Juss. ex Arn.
- 64b. *Myrtineae* Burnett
- 254. **Vochysiaceae** A.St.-Hil.
  - a. *Vochysioideae* Takht.
  - b. *Erismoideae* Takht.
- 255. **Myrtaceae** Juss.
  - a. *Heteropyxidoideae* Reveal
    - a1. *Heteropyxideae* Harv.
    - a2. *Psiloxyleae* A.J. Scott
  - b. *Myrtoideae* Sweet
    - b1. *Xanthostemoneae* Peter G. Wilson
    - b2. *Lophostemoneae* Peter G. Wilson
    - b3. *Osborneae* Peter G. Wilson
    - b4. *Melaleuceae* Burnett
    - b5. *Kanieae* Peter G. Wilson ex Reveal
    - b6. *Backhouseae* Peter G. Wilson
    - b7. *Metrosidereae* Peter G. Wilson
    - b8. *Tristanieae* Peter G. Wilson
    - b9. *Syzygieae* Peter G. Wilson
    - b10. *Myrteae* DC.
    - b11. *Eucalypteae* Peter G. Wilson
    - b12. *Syncarpieae* Peter G. Wilson
    - b13. *Lindsayomyrteae* Peter G. Wilson
    - b14. *Leptospermeae* DC.
    - b15. *Chamelaucieae* DC.
- 64c. *Melastomatineae* J. Presl
- 256. **Melastomataceae** Juss.
  - a. *Olisbeioideae* Burnett
  - b. *Melastomatoideae* Scr. ex DC.
    - b1. *Kibessiae* Krasser
    - b2. *Astronieae* Triana
    - b3. *Sonerileae* Triana
    - b4. *Melastomateae* Bartl.
      - b4a. *Merianiinae* Baill.
      - b4b. *Rhexinae* Baill.
      - b4c. *Melastomatinae* Baill.
      - b4d. *Microliciinae* Baill.
      - b4e. *Miconinae* Meisn.
      - b4f. *Blakeinae* Gilg
- 257. **Crypteroniaceae** A. DC.
- 258. **Alzateaceae** S.A. Graham
- 259. **Rhynchoalycaceae** L.A.S. Johnson & B.G. Briggs
- 260. **Penaeaceae** Sweet ex Guill.
- 261. **Oliniaceae** Harv. & Sond.
- 65. **CROSSOSOMATALES** Takht. ex Reveal
  - 65a. *Crossosomatineae* Reveal



- 262. **Staphyleaceae** Martinov
- 263. **Guamatelaceae** S. Oh & D. Potter
- 264. **Stachyuraceae** J. Agardh
- 265. **Crossosomataceae** Engl.
- 65b. **Geissolomatineae** Reveal
- 266. **Aphloiaceae** Takht.
- 267. **Geissolomataceae** A. DC.
- 268. **Strasburgeriaceae** Tiegh.
- 269. **Ixerbaceae** Griseb. ex Doweld & Reveal
- 66. **PICRAMNIALES** Doweld
  - 270. **Picramniaceae** Fernando & Quinn
    - a. **Alvaradooideae** Engl.
    - b. **Picramnioideae** Engl.
- 67. **SAPINDALES** Juss. ex Bercht. & J. Presl
  - 67a. **Sapindineae** J. Presl
  - 271. **Biebersteiniaceae** Schnizl.
  - 272. **Nitrariaceae** Lindl.
  - 273. **Tetradiclidaceae** Takht.
  - 274. **Kirkiaceae** Takht.
  - 275. **Anacardiaceae** R. Br.
    - a. **Spondiadioideae** Kunth ex Arn.
      - a1. **Spondiadioideae** Kunth ex DC.
      - a2. **Rhoeae** Voigt
      - a3. **Semecarpae** Marchand
      - a4. **Pistacieae** Marchand
      - a5. **Dobineae** Engl.
    - b. **Anacardioidae** Arn.
      - b1. **Buchananieae** Marchand
      - b2. **Julanieae** Reveal
      - b3. **Anacardieae** DC.
  - 276. **Burseraceae** Kunth
    - a1. **Beiselieae** Thulin, Beier & Razafim.
    - a2. **Protieae** Marchand
    - a3. **Bursereae** DC.
    - a4. **Canarineae** Webb & Berthel.
      - a4a. **Canarininae** Eddie ex Reveal
      - a4b. **Garuginae** Engl.
- 277. **Xanthoceraceae** Buerki, Callm. & Lowry
- 278. **Hippocastanaceae** A. Rich.
- 279. **Aceraceae** Juss.
- 280. **Sapindaceae** Juss.
  - a. **Dodonaeoideae** Burnett
    - a1. **Doratoxyleae** Radlk.
    - a2. **Dodonaceae** Kunth ex DC.
  - b. **Sapindoideae** Burnett
    - b1. **Delavayeae** Reveal
    - b2. **Koelreuterieae** Radlk.
    - b3. **Schleichereae** Radlk.
    - b4. **Sapindeae** Kunth ex DC.
    - b5. **Cupanieae** Blume
    - b6. **Melicocceae** Blume

- b7. **Paullinieae** Kunth ex DC.
- 67b. **Rutineae** Doweld ex Reveal
  - 281. **Rutaceae** Juss.
    - a. **Rutoideae** Arn.
    - b. **Amyridoideae** Arn.
      - b1. **Dictamneneae** Bartl.
      - b2. **Amyrideae** DC.
      - b3. **Diosmeae** DC.
      - b4. **Zanthoxyleae** Dumort.
      - b5. **Boroneiae** Bartl.
      - b6. **Galipeae** Kallunki
    - c. **Aurantiodeae** Eaton
      - c1. **Pteleae** DC.
      - c2. **Clauseneae** Wight & Arn.
      - c3. **Aurantiae** Rehb.
    - d. **Cneoroideae** Webb
      - d1. **Spathelieae** Planch.
      - d2. **Cneoreae** Baill.
  - 282. **Meliaceae** Juss.
    - a. **Meliodeae** Arn.
      - a1. **Turraeeae** Harms
      - a2. **Melieae** DC.
      - a3. **Quivisiantheae** Reveal
      - a4. **Trichilieae** DC.
      - a5. **Vavaeeae** Harms
      - a6. **Aglaieae** Blume
      - a7. **Guareae** T.D. Penn. & Styles
      - a8. **Sandoriceae** T.D. Penn. & Styles
    - b. **Cedreloideae** Arn.
      - b1. **Capuroniantheae** Mabberley ex Reveal
      - b2. **Swietenieae** A. Juss.
      - b3. **Cedreleae** DC.
      - b4. **Xylocarpeae** Blume
  - 283. **Simaroubaceae** DC.
    - a1. **Casteleae** Bartl.
    - a2. **Ailanthae** Meisn.
    - a3. **Leitnerieae** Baill.
    - a4. **Quassieae** Baill.
    - a5. **Simaroubeae** Dumort.
- 68. **HUERTEALES** Doweld
  - 284. **Peteneaceae** Christh., M.W. Chase & M.F. Fay
  - 285. **Gerrardinaceae** M.H. Alford
  - 286. **Tapisciaceae** Takht.
  - 287. **Dipentodontaceae** Merr.
- 69. **MALVALES** Juss. ex Bercht. & J. Presl
  - 69a. **Thymelaeineae** Engl.
  - 288. **Neuradaceae** Kostel.
  - 289. **Thymelaeaceae** Juss.
    - a. **Tepuianthoideae** Reveal
    - b. **Gonystyloideae** Domke
      - b1. **Octolepideae** Thonner

- b2. Gonystyleae Reveal
  - c. Thymelaeoideae Burnett
    - c1. Synandrodaphneae Herber
    - c2. Aquilarieae Horan.
    - c3. Thymelaeeae Endl.
- 69b. Cochlospermineae Engl.
  - 290. **Sphaerosepalaceae** Tiegh.
  - 291. **Cochlospermaceae** Planch.
  - 292. **Bixaceae** Kunth
  - 293. **Diegodendraceae** Capuron
- 69c. Cistineae Rchb.
  - 294. **Cistaceae** Juss.
  - 295. **Sarcolaenaceae** Caruel
  - 296. **Dipterocarpaceae** Blume
    - a. Pakaramaeoideae Maguire, P.S. Ashton & de Zeeuw
    - b. Monotoideae Thonner
    - c. Dipterocarpoideae Burnett
      - c1. Dipterocarpeae Rchb.
      - c2. Shoreaeae Miq.
  - 297. **Cytinaceae** A. Rich.
  - 298. **Muntingiaceae** C. Bayer, M.W. Chase & M.F. Fay
    - a. Muntingioideae Reveal
    - b. Neotessmannioideae Burret
- 69d. Malvineae Rchb.
  - 299. **Sparmanniaceae** J. Agardh
    - a1. Grewiae Endl.
    - a2. Sparmanniae Burret
  - 300. **Byttneriaceae** R. Br.
    - a1. Lasiopetaleae DC.
    - a2. Hermanniae DC.
    - a3. Byttneriae DC.
    - a4. Theobromateae A. Stahl
  - 301. **Sterculiaceae** Vent.
  - 302. **Tiliaceae** Juss.
    - a1. Tiliaceae Bartl.
    - a2. Craigieae H.T. Chang & R.H. Miao
  - 303. **Dombeyaceae** Desf.
  - 304. **Berryaceae** Doweld
    - a1. Berryae Burret
    - a2. Brownlowiae Benth.
  - 305. **Helicteraceae** J. Agardh
    - a1. Durioneae Becc.
    - a2. Helicterae Schott & Endl.
    - a3. Eriolaeneae Arn.
    - a4. Mansoniae Prain
  - 306. **Bombacaceae** Kunth
    - a1. Chiranthodendreae Baill.
    - a2. Ochromeae Horan.
    - a3. Bombaceae Kunth
  - 307. **Malvaceae** Juss.
    - a1. Kydieae Bates

- a2. **Hibisceae** Rchb.
- a3. **Gossypieae** Alef.
- a4. **Malveae** J. Presl
  - a4a. **Corynabutilinae** Kearney
  - a4b. **Malvinae** K. Schum.
- a5. **Sideae** J. Presl
  - a5a. **Abutilinae** A. Gray
  - a5b. **Sidinae** A. Gray
- 70. **CAPPARALES** Juss. ex Bercht. & J. Presl
  - 308. **Akaniaceae** Stapf
  - 309. **Bretschneideraceae** Engl. & Gilg
  - 310. **Tropaeolaceae** Juss. ex DC.
  - 311. **Moringaceae** Martinov
  - 312. **Caricaceae** Dumort.
  - 313. **Setchellanthaceae** Iltis
  - 314. **Limnanthaceae** R. Br.
  - 315. **Koeberliniaceae** Engl.
  - 316. **Bataceae** Mart. ex Perleb
  - 317. **Salvadoraceae** Lindl.
  - 318. **Emblingiaceae** Airy Shaw
  - 319. **Pentadiplandraceae** Hutch. & Dalziel
  - 320. **Stixaceae** Doweld
  - 321. **Gyrostemonaceae** A. Juss.
  - 322. **Resedaceae** Martinov
    - a1. **Cayluseae** Müll.-Arg.
    - a2. **Astrocarpae** Müll.-Arg.
    - a3. **Resedae** Rchb.
  - 323. **Tovariaceae** Pax
  - 324. **Capparaceae** Juss.
    - a1. **Cappareae** DC.
    - a2. **Maerueae** Baill.
    - a3. **Cadabeae** Horan.
  - 325. **Cleomaceae** Bercht. & J. Presl
    - a. **Diptyrgioideae** Pax
    - b. **Cleomoideae** Burnett
  - 326. **Brassicaceae** Burnett
    - a1. **Aethionemeae** Al-Shehbaz, Beilstein & E.A. Kellogg
    - a2. **Camelineae** DC.
    - a3. **Boechereae** Al-Shehbaz, Beilstein & E.A. Kellogg
    - a4. **Halimolobeae** Al-Shehbaz, Beilstein & E.A. Kellogg
    - a5. **Physarieae** B.L. Rob.
    - a6. **Cardamineae** Dumort.
    - a7. **Lepidieae** DC.
    - a8. **Alysseae** DC.
    - a9. **Descurainieae** Al-Shehbaz, Beilstein & E.A. Kellogg
    - a10. **Smelowskieae** Al-Shehbaz, Beilstein & E.A. Kellogg
    - a11. **Arabideae** DC.
    - a12. **Brassiceae** DC.
    - a13. **Schizopetaleae** R. Br. ex Barnéoud
    - a14. **Sisymbrieae** DC.
    - a15. **Isatideae** DC.

- a16. *Eutremeae* Al-Shehbaz, Beilstein & E.A. Kellogg
- a17. *Bivonaeae* M. Koch & Warwick
- a18. *Thlaspieae* DC.
- a19. *Noccaeae* Al-Shehbaz, Beilstein & E.A. Kellogg
- a20. *Hesperideae* Prantl
- a21. *Anchonaeae* DC.
- a22. *Euclidieae* DC.
- a23. *Chorisporaeae* Ledeb., C.A. Mey. & Bunge
- a24. *Heliophileae* DC.
- a25. *Cochleariaeae* Buchenau
- a26. *Lunariaeae* Dumort.
- a27. *Iberideae* Webb & Berthel.
- O. **Berberidopsidanae** Thorne & Reveal
  - 71. **BERBERIDOPSIDALES** Doweld
    - 327. **Aextoxicaceae** Engl. & Gilg
    - 328. **Berberidopsidaceae** Takht.
- P. **Santalanae** Thorne ex Reveal
  - 72. **SANTALALES** R. Br. ex Bercht. & J. Presl
    - 329. **Erythralaceae** Planch. ex Miq.
    - 330. **Strombosiaceae** Tiegh.
    - 331. **Coulaceae** Tiegh.
    - 332. **Ximeniaceae** Horan.
    - 333. **Aptandraceae** Miers
    - 334. **Olacaceae** Juss. ex R. Br.
    - 335. **Octoknemaceae** Tiegh.
    - 336. **Schoepfiaceae** Blume
    - 337. **Misodendraceae** J. Agardh
    - 338. **Loranthaceae** Juss.
      - a1. *Nuytsiaeae* Tiegh.
      - a2. *Gaiadendreae* Tiegh.
      - a3. *Elytrantheae* Danser
      - a4. *Psittacanthaeae* Horan.
        - a4a. *Tupeinae* Nickrent & Vidal-Russell
        - a4b. *Notantherinae* Nickrent & Vidal-Russell
        - a4c. *Ligarinae* Nickrent & Vidal-Russell
        - a4d. *Psittacanthinae* Engl.
      - a5. *Loranthaeae* Rchb.
        - a5a. *Ileostylinae* Nickrent & Vidal-Russell
        - a5b. *Loranthinae* Engl.
        - a5c. *Amyeminae* Nickrent & Vidal-Russell
        - a5d. *Scurrulinae* Nickrent & Vidal-Russell
        - a5e. *Dendrophthoinae* Nickrent & Vidal-Russell
        - a5f. *Emelianthinae* Nickrent & Vidal-Russell
        - a5g. *Tapinanthinae* Nickrent & Vidal-Russell
  - 339. **Opiliaceae** Valetton
    - a1. *Anthoboleae* Bartl. ex Spach
    - a2. *Opilieae* Benth.
    - a3. *Agonandreae* Engl.
  - 340. **Comandraceae** Nickrent & Vidal-Russell
  - 341. **Thesiaceae** Vest
  - 342. **Cervantesiaceae** Nickrent & Vidal-Russell

- 343. **Nanodeaceae** Nickrent & Vidal-Russell
- 344. **Santalaceae** R. Br.
- 345. **Amphorogynaceae** Nickrent & Der
- 346. **Viscaceae** Batsch
- 73. **BALANOPHORALES** Dumort.
- 347. **Balanophoraceae** Rich.
  - a. **Mystroptaloideae** Engl.
  - b. **Dactylanthoideae** Engl.
  - c. **Sarcophytoideae** Engl.
  - d. **Scybalioidae** Engl.
  - e. **Lophophytoideae** Engl.
  - f. **Balanophoroideae** Engl.
    - f1. **Balanophoreae** Engl.
    - f2. **Langsdorffiae** Schott & Endl.
- Q. **Caryophyllanae** Takht.
- 74. **POLYGONALES** Juss. ex Bercht. & J. Presl
- 348. **Plumbaginaceae** Juss.
  - a. **Plumbaginoidae** Burnett
  - b. **Limonioidae** Reveal
    - b1. **Aegialitideae** T.H. Peng
    - b2. **Limoniae** Reveal
- 349. **Polygonaceae** Juss.
  - a. **Symmerioideae** Meisn.
  - b. **Polygonoideae** Eaton
    - b1. **Fagopyreae** Yonek.
    - b2. **Calligoneae** C.A. Mey.
    - b3. **Rumiceae** Dumort.
    - b4. **Persicariae** Dumort.
    - b5. **Polygoneae** Rchb.
  - c. **Eriogonoideae** Arn.
    - c1. **Brunnichieae** C.A. Mey.
    - c2. **Coccolobeae** Dumort.
    - c3. **Leptogeneae** Jan. M. Burke & Adr. Sanchez
    - c4. **Triplaridae** C.A. Mey.
    - c5. **Gymnopodieae** Jan. M. Burke & Adr. Sanchez
    - c6. **Eriogoneae** Dumort.
- 75. **NEPENTHALES** Dumort.
- 350. **Droseraceae** Salisb.
- 351. **Nepenthaceae** Dumort.
- 352. **Drosophyllaceae** Chrték, Slavíková & Studnička
- 353. **Ancistrocladaceae** Planch. ex Walp.
- 354. **Dioncophyllaceae** Airy Shaw
- 76. **TAMARICALES** Link
- 355. **Frankeniaceae** Desv.
- 356. **Tamaricaceae** Link
  - a1. **Reaumurieae** Horan.
  - a2. **Tamariceae** Rchb.
- 77. **CARYOPHYLLALES** Juss. ex Bercht. & J. Presl
- 77a. **Rhabdodendrineae** Shipunov
- 357. **Rhabdodendraceae** Prance
- 77b. **Simmondsiineae** Reveal

- 358. **Simmondsiaceae** Tiegh.
- 359. **Asteropeiaceae** Takht. ex Reveal & Hoogland
- 360. **Physenaceae** Takht.
- 361. **Microteaceae** Schäferhoff & Borsch
- 77c. **Stegnospermatineae** Nakai
- 362. **Stegnospermataceae** Nakai
- 77d. **Caryophyllineae** Bessey
- 363. **Caryophyllaceae** Juss.
  - a. **Illecebroideae** Arn.
    - a1. **Corrigioleae** Dumort.
    - a2. **Paronychieae** Dumort.
    - a3. **Polycarpaeae** DC.
    - a4. **Sperguleae** Dumort.
  - b. **Caryophylloideae** Arn.
    - b1. **Sileneae** DC.
    - b2. **Caryophylleae** Lam. & DC.
  - c. **Alsinoideae** Beilschm.
    - c1. **Eremogoneae** Rabeler & W.L. Wagner
    - c2. **Arenarieae** Kitt.
    - c3. **Alsineae** Lam. & DC.
    - c4. **Sagineae** J. Presl
    - c5. **Scleranthaeae** Link ex DC.
- 77e. **Chenopodiineae** J. Presl
- 364. **Achatocarpaceae** Heimerl
- 365. **Chenopodiaceae** Vent.
  - a. **Betoideae** Ulbr.
  - b. **Chenopodioidae** Burnett
    - b1. **Axyrideae** G. Kadereit & A. Sukhor
    - b2. **Chenopodieae** Dumort.
    - b3. **Dysphanieae** Pax
    - b4. **Atripliceae** Duby
    - b5. **Sclerolaeneae** A.J. Scott
  - c. **Salicornioideae** Luerss.
    - c1. **Haloephylidae** Ulbr.
    - c2. **Salicornieae** Dumort.
  - d. **Corispermoideae** Raf.
  - e. **Salsoloideae** Raf.
    - e1. **Suaedeae** Moq.
    - e2. **Salsoleae** Dumort.
- 366. **Amaranthaceae** Juss.
  - a. **Polycnemoideae** Raf.
  - b. **Gomphogynoideae** Luerss.
    - b1. **Pseudoplantageae** Covas
    - b2. **Gomphreneae** Fenzl
  - c. **Amaranthoideae** Burnett
    - c1. **Celosieae** Fenzl
    - c2. **Amarantheae** Rchb.
- 77f. **Nyctaginineae** Nakai
- 367. **Limeaceae** Shipunov ex Reveal
- 368. **Lophiocarpaceae** Doweld & Reveal
- 369. **Barbeuiaceae** Nakai

- 370. **Aizoaceae** Martinov
  - a. **Tetragonioideae** Lindl.
  - b. **Aizooideae** Spreng. ex Arn.
  - c. **Mesembryanthemoideae** Burnett
  - d. **Ruschioideae** Schwantes
    - d1. **Apatesieae** Schwantes
    - d2. **Dorotheanthae** Chesselet, G.F. Sm. & A.E. van Wyk
    - d3. **Ruschieae** Schwantes
- 371. **Gisekiaceae** Nakai
- 372. **Sarcobataceae** Behnke
- 373. **Agdestidaceae** Nakai
- 374. **Nyctaginaceae** Juss.
  - a1. **Leucastereae** Benth. & Hook.f.
  - a2. **Boldoeae** Heimerl
  - a3. **Colignonieae** Heimerl
  - a4. **Bougainvilleae** Choisy
  - a5. **Pisonieae** Meisn.
  - a6. **Nyctagineae** Horan.
  - a7. **Caribeeae** Douglas & Spellenb.
- 375. **Phytolaccaceae** R. Br.
- 376. **Petiveriaceae** C. Agardh
- 77g. **Portulacineae** Engl.
- 377. **Molluginaceae** Bartl.
- 378. **Montiaceae** Raf.
- 379. **Halophytaceae** A.Soriano
- 380. **Basellaceae** Raf.
- 381. **Didiereaceae** Radlk.
  - a. **Didiereoideae** Appleq. & R.S. Wallace
  - b. **Portulacarioideae** Appleq. & R.S. Wallace
  - c. **Calyptrothecoideae** Pax & Gilg
- 382. **Talinaceae** Doweld
- 383. **Portulacaceae** Juss.
- 384. **Anacampserotaceae** Eggli & Nyffeler
- 385. **Cactaceae** Juss.
  - a. **Pereskioideae** Engelm.
  - b. **Opuntioideae** Burnett
    - b1. **Austrocylindropuntieae** R.S. Wallace & S.L. Dickie
    - b2. **Cylindropuntieae** Doweld
    - b3. **Opuntieae** DC.
    - b4. **Pterocacteae** Kuntze
    - b5. **Tephrocacteae** Doweld
  - c. **Maihueñoideae** P. Fearn
  - d. **Blossfeldioideae** Crozier
    - d1. **Blossfeldieae** Crozier
    - d2. **Copiapoeae** Doweld
  - e. **Cactoideae** Eaton
    - e1. **Browningieae** Buxb.
    - e2. **Cereae** Salm-Dyck
    - e3. **Trichocereae** Buxb.
    - e4. **Notocacteae** Buxb.
    - e5. **Rhipsalideae** DC.



- e6. *Lymanbensoniae* N. Korotkova & Barthlott
- e7. *Hylocereeae* Buxb.
- e8. *Pachycereeae* Buxb.
- e9. *Cacteae* Rchb.

R. **Cornanae** Thorne ex Reveal

78. **CORNALES** Link

- 386. **Cornaceae** Bercht. & J. Presl
  - a. *Alangioideae* Burnett
  - b. *Cornoideae* Endl.
  - c. *Davidioideae* Harms
  - d. *Nyssoideae* Arn.
  - e. *Mastixioideae* Harms
- 387. **Hydrangeaceae** Dumort.
  - a. *Jamesioideae* L. Hufford
  - b. *Hydrangeoideae* Burnett
    - b1. *Philadelphaeae* DC. ex Duby
      - b1a. *Philadelphinae* Reveal
      - b1b. *Kirengeshominae* Reveal
    - b2. *Hydrangeae* DC.
- 388. **Loasaceae** Juss.
  - a. *Mentzelioideae* Gilg
  - b. *Petalonychoideae* Weigend
  - c. *Gronovioideae* M. Roem.
  - d. *Loasoideae* Gilg
    - d1. *Loaseae* Rchb.
    - d2. *Klaprothiaeae* Gilg
- 389. **Hydrostachyaceae** Engl.
- 390. **Grubbiaceae** Endl. ex Meisn.
- 391. **Curtisiaceae** Takht.

S. **Ericanae** Takht.

- 79. **ERICALES** Bercht. & J. Presl
- 79a. **Balsaminineae** Engl.
- 392. **Balsaminaceae** A. Rich.
- 393. **Marcgraviaceae** Bercht. & J. Presl
  - a. *Marcgravioideae* Choisy
  - b. *Norantioideae* Choisy
- 394. **Tetrameristaceae** Hutch.
- 79b. **Polemoniineae** Bessey
- 395. **Polemoniaceae** Juss.
  - a. *Polemonioideae* Arn.
    - a1. *Polemoniaeae* Dumort.
    - a2. *Phlocideae* Dumort.
    - a3. *Gilieae* V.E. Grant
    - a4. *Loeselieae* J.M. Porter & L.A. Johnson
  - b. *Cobaeoideae* Arn.
    - b1. *Cobaeaeae* Meisn.
    - b2. *Cantueae* Peter
    - b3. *Bonplandiaeae* Baill.
  - c. *Acanthogilioideae* J.M. Porter & L.A. Johnson
- 396. **Fouquieriaceae** DC.
- 79c. **Scytotepalineae** Engl.

- 397. **Napoleonaceae** A. Rich.
- 398. **Scytopetalaceae** Engl.
- 399. **Lecythidaceae** A. Rich.
  - a. Asteranthoideae Reveal
  - b. Barringtonioideae Beilschm.
  - c. Lecythidoideae Beilschm.
- 79d. Primulineae Burnett
- 400. **Sladeniaceae** Airy Shaw
- 401. **Pentaphylacaceae** Engl.
  - a1. Pentaphylaceae P.F. Stevens & A.L. Weitzman
  - a2. Ternstroemiaceae DC.
  - a3. Freziaceae DC.
- 402. **Sapotaceae** Juss.
  - a. Sarcospermatoideae Swenson & Anderb.
  - b. Sapotoideae Eaton
    - b1. Sapoteae Rchb.
    - b2. Palaquieae Engl.
    - b3. Sideroxyleae Small
  - c. Chrysophylloideae Luer.
    - c1. Chrysophylleae Small
    - c2. Omphalocarpeae Duband ex Aubrév.
- 403. **Ebenaceae** Gürke
  - a. Lissocarpoideae B. Walln.
  - b. Ebenoideae Thorne & Reveal
- 404. **Maesaceae** Anderb., B. Stühl & Källersjö
- 405. **Theophrastaceae** G. Don
- 406. **Myrsinaceae** R. Br.
- 407. **Samolaceae** Raf.
- 408. **Primulaceae** Batsch ex Borkh.
  - a1. Primuleae Dumort.
  - a2. Androsaceae Rchb. ex Pax
  - a3. Ardisiandreae O. Schwarz
- 409. **Lysimachiaceae** Juss.
  - a1. Lysimachieae Rchb.
  - a2. Corideae Dumort.
- 79e. Theineae Engl.
- 410. **Mitrastemonaceae** Makino
- 411. **Theaceae** Mirb. ex Ker Gawl.
  - a1. Theae Szyszyl.
  - a2. Gordonieae DC.
  - a3. Stewartieae Choisy
- 412. **Symplocaceae** Desf.
- 413. **Styracaceae** DC. & Spreng
- 414. **Diapensiaceae** Lindl.
- 79f. Sarraceniineae Reveal
- 415. **Sarraceniaceae** Dumort.
- 416. **Actinidiaceae** Engl. & Gilg
  - a. Actinidioideae Gilg
  - b. Saurauioideae Gilg
  - c. Clematoclethroidae Gilg
- 417. **Roridulaceae** Martinov

- 79g. **Ericineae** Link
- 418. **Clethraceae** Klotzsch
- 419. **Cyrillaceae** Lindl.
- 420. **Ericaceae** Juss.
  - a. **Enkianthoideae** Kron, Judd & Anderb.
  - b. **Monotropeoideae** Arn.
    - b1. **Pyroleae** Dumort.
    - b2. **Monotropeae** Dumort.
    - b3. **Pterosporae** Baill.
  - c. **Arbutoideae** Nied.
  - d. **Cassiopoideae** Kron & Judd
  - e. **Harrimanelloideae** Kron & Judd
  - f. **Ericoideae** Arn.
    - f1. **Phylloidoceae** Drude
    - f2. **Bryanthae** Gillespie & Kron
    - f3. **Ericae** DC. ex Duby
    - f4. **Empetreae** Horan.
    - f5. **Rhodoreae** DC. ex Duby
  - g. **Empetroideae** Sweet
  - h. **Epacridoideae** Arn.
    - h1. **Prionoteae** Drude
    - h2. **Archerieae** Crayn & Quinn
    - h3. **Oligarrheneae** Crayn & Quinn
    - h4. **Richeae** Crayn & Quinn
    - h5. **Epacrideae** Dumort.
    - h6. **Cosmelieae** Crayn & Quinn
    - h7. **Stenanthereae** Dumort.
  - i. **Vaccinioideae** Arn.
    - i1. **Oxydendreae** Cox ex Reveal
    - i2. **Lyonieae** Kron & Judd
    - i3. **Andromedeae** Klotzsch
    - i4. **Gaultherieae** Nied.
    - i5. **Vaccinieae** Rehb.
- T. **Lamianae** Takht.
- 80. **GARRYALES** Mart.
  - 421. **Garryaceae** Lindl.
  - 422. **Aucubaceae** Bercht. & J. Presl
  - 423. **Eucommiaceae** Engl.
- 81. **ICACINALES** Tiegh.
  - 424. **Oncothecaceae** Kobuski ex Airy Shaw
  - 425. **Metteniusaceae** H. Karst. ex Schnizl.
  - 426. **Icacinaceae** Miers
    - a1. **Emmoteae** Miers
    - a2. **Icachineae** Benth.
    - a3. **Iodeae** Engl.
    - a4. **Phytocreneae** Benth. & Hook.f.
    - a5. **Sarcostigmateae** Miers
- 82. **GENTIANALES** Juss. ex Bercht. & J. Presl
  - 427. **Rubiaceae** Juss.
    - a. **Cinchonoideae** Raf.
      - a1. **Chiococceae** Benth. & Hook.f.

- a2. Cinchoneae DC.
- a3. Coptosapelteae Bremek. ex S.P. Darwin
- a4. Guettardeae DC.
- a5. Hamelieae A. Rich. ex DC.
- a6. Hillieae Bremek. ex S.P. Darwin
- a7. Hymenodictyoneae Razafim. & B. Bremer
- a8. Iserctieae A. Rich. ex DC.
- a9. Naucleae Burnett
- a10. Rondeletieae Burnett
- b. Dialypetalanthoideae Reveal
  - b1. Alberteae Sond.
  - b2. Bertiereae Bridson
  - b3. Coffeae DC.
  - b4. Dialypetalantheae Reveal
  - b5. Cremasporeae Bremek. ex S.P. Darwin
  - b6. Gardenieae A. Rich. ex DC.
  - b7. Ixoreae Benth. & Hook.f.
  - b8. Mussaendeae Benth. & Hook.f.
  - b9. Octotropideae Bedd.
  - b10. Pavetteae Dumort.
  - b11. Posoquerieae Delprete
  - b12. Retiniphyllae Benth. & Hook.f.
  - b13. Sabiceae A. Stahl
  - b14. Sipaneeae Bremek.
  - b15. Vanguerieae Dumort.
- c. Rubioideae Bremek. ex Verdc.
  - c1. Colletocemateae Rydin & B. Bremer
  - c2. Urophyllae Bremek. ex Verdc.
  - c3. Ophiorrhizeae Bremek. ex Verdc.
  - c4. Lasiantheae B. Bremer & Manen
  - c5. Coussareae Benth. & Hook.f.
  - c6. Psychotrieae Cham. & Schltldl.
  - c7. Schradereae Bremek.
  - c8. Mitchellae Razafim. & B. Bremer
  - c9. Craterispermeae Verdc.
  - c10. Gaertnereae Endl.
  - c11. Morindeae Burnett
  - c12. Schizocoleae Rydin & B. Bremer
  - c13. Spermacoeae Cham. & Schltldl. ex DC.
  - c14. Knoxiae Benth. & Hook.f.
  - c15. Danaideae B. Bremer & Manen
  - c16. Dunniae Rydin & B. Bremer
  - c17. Theligoneae Baill.
  - c18. Rubieae Baill.
    - c18a. Theligoninae Robbr. & Manen
    - c18b. Kelloggiinae Robbr. & Manen
    - c18c. Rubiinae Robbr. & Manen
  - c19. Paederieae DC.
  - c20. Argostemmateae Bremek. ex Verdc.
  - c21. Anthospermeae Cham. & Schltldl.
    - c21a. Anthosperminae Benth.

- c21b. *Coprosminae* Fosc.
- c21c. ***Operculariinae*** Benth.
- 428. ***Gentianaceae*** Juss.
  - a1. *Saccifolieae* Struwe, Thiv, V.A. Albert & Kadereit
  - a2. *Exaceae* Colla
  - a3. *Chironiinae* Dumort.
    - a3a. *Chironiinae* G. Don
    - a3b. *Canscoriinae* Thiv & Kadereit
    - a3c. *Coutoubeinae* G. Don
  - a4. *Potaliinae* Endl.
    - a4a. *Potaliinae* Progel
    - a4b. *Faroinae* Struwe & V.A. Albert
    - a4c. *Lisianthiinae* G. Don
  - a5. *Helieae* Gilg
  - a6. *Gentianeae* Dumort.
    - a6a. *Gentianinae* G. Don
    - a6b. *Swertiinae* Griseb.
  - a7. *Voyriinae* Gilg
- 429. ***Loganiaceae*** R. Br. ex Mart.
  - a1. *Loganiinae* Kitt.
  - a2. *Strychnae* Soler.
  - a3. *Antonieae* Endl.
  - a4. *Spigeliinae* Dumort.
- 430. ***Gelsemiaceae*** L. Struwe & V.A. Albert
- 431. ***Pteleocarpaceae*** Brummitt
- 432. ***Apocynaceae*** Juss.
  - a. *Carissoideae* Endl.
    - a1. *Alstoniinae* G. Don
    - a2. *Vinceae* Duby
    - a3. *Willughbeeae* A. DC.
    - a4. *Tabernaemontaneae* G. Don
    - a5. *Melodineae* G. Don
    - a6. *Hunteriinae* Miers
    - a7. *Plumeriinae* E. Mey.
    - a8. *Carisseae* Dumort.
    - a9. *Alyxiinae* G. Don
  - b. *Apocynoideae* Burnett
    - b1. *Wrightiinae* G. Don
    - b2. *Malouetiae* Müll.-Arg.
    - b3. *Apocynae* Rehb.
    - b4. *Mesechiteae* Miers
    - b5. *Echiteae* Bartl.
  - c. *Periplocoideae* Endl.
  - d. *Secamonoideae* Endl.
  - e. *Asclepiadoideae* Burnett
    - e1. *Fockeae* H. Kunze, Meve & Liede
    - e2. *Marsdeniinae* Benth.
    - e3. *Ceropegiae* Orb.
    - e4. *Asclepiadeae* Duby
- 83. **SOLANALES** Juss. ex Benth. & J. Presl
  - 83a. *Solaninae* J. Presl

- 433. **Montiniaceae** Nakai
  - a1. **Montinieae** DC.
  - a2. **Kaliphoreae** Reveal
- 434. **Sphenocleaceae** T. Baskerv.
- 435. **Hydroleaceae** R. Br. ex Edwards
- 436. **Convolvulaceae** Juss.
  - a. **Humbertioideae** Roberty
  - b. **Convolvuloideae** Burnett
    - b1. **Aniseieae** Stefanović & D.F. Austin
    - b2. **Poraneae** Hallier f.
    - b3. **Convolvuleae** Dumort.
    - b4. **Cresseae** C.B. Clarke
    - b5. **Dichondreae** Choisy ex G. Don
    - b6. **Erycibeae** Hogg
    - b7. **Ipomoeae** Hallier f.
    - b8. **Jacquemontieae** Stefanović & D.F. Austin
    - b9. **Maripeae** Webb & Berthel.
    - b10. **Merremieae** D.F. Austin
  - c. **Cuscutioideae** Burnett
- 437. **Solanaceae** Juss.
  - a. **Schizanthoideae** Hunz.
  - b. **Goetzeoideae** Thorne & Reveal
  - c. **Duckeodendroideae** Reveal
  - d. **Cestroideae** Burnett
    - d1. **Benthamielleae** Hunz.
    - d2. **Browallieae** Hunz.
    - d3. **Cestreae** Dumort.
    - d4. **Salpiglossideae** Benth.
  - e. **Schwenckioideae** Reveal
  - f. **Petunioideae** Thorne & Reveal
  - g. **Nicotianoideae** Miers
    - g1. **Anthocercideae** G. Don
    - g2. **Nicotianeae** Dumort.
  - h. **Solanoideae** Burnett
    - h1. **Nicandreae** Lowe
    - h2. **Mandragoreae** Rchb.
    - h3. **Hyoscyameae** Endl.
      - h3a. **Hyoscyaminae** Kitt.
      - h3b. **Lyciinae** Hogg
      - h3c. **Jaborosinae** Reveal
    - h4. **Nolaneae** Rchb.
    - h5. **Capsiceae** Dumort.
    - h6. **Datureae** Dumort.
    - h7. **Physalideae** Miers
      - h7a. **Iochrominae** Reveal
      - h7b. **Physalidinae** Reveal
      - h7c. **Witheringinginae** Reveal
      - h7d. **Salpichroinae** Reveal
    - h8. **Solaneae** Dumort.
    - h9. **Juanulloae** Hunz.
  - i. **Sclerophylloideae** Thorne & Reveal

## 83b. Boraginineae Engl.

438. **Boraginaceae** Juss.

## a. Boraginoideae Arn.

- a1. Trigonotideae H. Riedl
- a2. Rochelieae A. DC.
- a3. Boragineae Rchb.
- a4. Cynoglosseae W.D.J. Koch
- a5. Echiochileae Långström & M.W. Chase
- a6. Lithospermeae Dumort.

## b. Codonoideae Rctief &amp; A.E. van Wyk

## c. Wellstedioideae Pilg.

## d. Hydrophyllloideae Burnett

- d1. Hydrophyllae Rchb.
- d1a. Phaceliinae Reveal
- d1b. Hydrophyllinae Reveal
- d1c. Romanzoffiinae Reveal

## e. Heliotropoideae Arn.

## f. Ehretioideae Arn.

## g. Cordioideae Beilschm.

- g1. Hoplestigmatae Reveal
- g2. Cordieae Dumort.

## h. Lennooideae Craven

## 84. VAHLIALES Doweld

439. **Vahliaceae** Dandy

## 85. LAMIALES Bromhead

## 85a. Oleineae J. Presl

440. **Plocospermataceae** Hutch.441. **Carlemanniaceae** Airy Shaw442. **Oleaceae** Hoffmanns. & Link

- a1. Fontanesieae H. Taylor ex L.A.S. Johnson
- a2. Forsythieae H. Taylor ex L.A.S. Johnson
- a3. Myxopyreae Boerl.
- a4. Jasmineae Lam. & DC.
- a5. Oleae Hoffmanns. & Link ex Dumort.
- a5a. Fraxininae E. Wallander & V.A. Albert
- a5b. Schreberinae E. Wallander & V.A. Albert
- a5c. Ligustrinae Koehne
- a5d. Oleinae E. Wallander & V.A. Albert

## 85b. Gesneriineae Link

443. **Tetrachondraceae** Wettst.444. **Calceolariaceae** Olmstead445. **Gesneriaceae** Rich. & Juss.

## a. Didymocarpoideae Arn.

- a1. Didymocarpeae Endl.
- a2. Epithematae Reveal

## b. Gesnerioideae Burnett

- b1. Napeanthae Wiehler
- b2. Coronanthereae Fritsch
- b3. Beslerieae Bartl.
- b4. Gloxinieae Sweet
- b5. Gesnerieae Dumort.

- b6. *Sinningieae* Fritsch
  - b7. *Episcieae* Endl.
- 85c. *Lamiineae* Bessey
- 446. **Plantaginaceae** Juss.
  - a1. *Gratiolieae* Benth.
  - a2. *Stemodieae* Reveal
  - a3. *Angelonieae* Pennell
  - a4. *Cheloneae* Benth.
  - a5. *Russelleae* Pennell
  - a6. *Antirrhineae* Dumort.
  - a7. *Callitricheae* Dumort.
  - a8. *Sibthorpieae* Benth.
  - a9. *Globularieae* Rchb.
  - a10. *Hemiphragmateae* Rouy
  - a11. *Digitalideae* Dumort.
  - a12. *Veroniceae* Duby
  - a13. *Plantagineae* Dumort.
- 447. **Scrophulariaceae** Juss.
  - a. *Hemimeridoideae* Reveal
    - a1. *Hemimerideae* Benth.
      - a1a. *Alonsoinae* Reveal
      - a1b. *Hemimeridinae* Reveal
  - b. *Myoporoideae* Arn.
    - b1. *Aptosimeae* Benth. & Hook.f.
    - b2. *Myoporeae* Rchb.
    - b3. *Leucophylleae* Miers
  - c. *Scrophularioideae* Beilschm.
    - c1. *Scrophularieae* Dumort.
    - c2. *Limoselleae* Dumort.
  - d. *Buddlejoideae* Engl.
    - d1. *Teedieae* Benth.
    - d2. *Buddlejeae* Bartl.
- 448. **Stilbaceae** Kunth
  - a1. *Hallerieae* G. Don
  - a2. *Bowkerieae* Barringer
  - a3. *Stilbeae* Hogg
- 449. **Lamiaceae** Martinov
  - a. *Symphorematoideae* Briq.
  - b. *Caryopteridoideae* Briq.
    - b1. *Callicarpeae* Briq.
    - b2. *Tectoneae* Briq.
  - c. *Viticoideae* Briq.
  - d. *Ajugoidae* Lucriss.
    - d1. *Clerodendreae* Briq.
    - d2. *Ajugeae* Benth.
    - d3. *Monochileae* Briq.
    - d4. *Teucriae* Dumort.
    - d5. *Caryopterideae* Benth. & Hook.f.
  - e. *Wenchengioideae* C.Y. Wu & S. Chow
  - f. *Prostantheroideae* Lucriss.
    - f1. *Chloantheae* Benth. & Hook.f.



- f2. *Westringieae* Bartl.
  - g. *Scutellarioideae* Prantl
  - h. *Lamioideae* Harley
    - h1. *Pogostemoneae* Briq.
    - h2. *Prasieae* Benth.
    - h3. *Marrubieae* Vis.
    - h4. *Lamieae* Coss. & Germ.
  - i. *Nepetoideae* Burnett
    - i1. *Elsholtzieae* Burnett
    - i2. *Saturejeae* Benth.
    - i3. *Prunelleae* Raf.
    - i4. *Meriandreae* Briq.
    - i5. *Lepechinieae* Briq.
    - i6. *Hormineae* Engl.
    - i7. *Mentheae* Dumort.
      - i7a. *Salviinae* Endl.
      - i7b. *Clinopodiinae* Dumort.
      - i7c. *Nepetinae* Coss. & Germ.
      - i7d. *Melissinae* Dumort.
    - j8. *Ocimeae* Dumort.
      - j8a. *Lavandulinae* Endl.
      - j8b. *Hanceolinae* A.J. Paton, Ryding & Harley
      - j8c. *Hyptidinae* Endl.
      - j8d. *Ociminae* J.A. Schmidt
      - j8e. *Plectranthinae* Endl.
- 450. **Mazaceae** Reveal
- 451. **Phrymaceae** Schauer
  - a1. *Leucocarpeae* Conzatti
  - a2. *Mimuleae* Dumort.
  - a3. *Phrymeae* Hogg
- 452. **Paulowniaceae** Nakai
- 453. **Rehmanniaceae** Reveal
- 454. **Orobanchaceae** Vent.
  - a. *Rhinanthoideae* Beilschm.
    - a1. *Pedicularideae* Duby
    - a2. *Rhinantheae* Lam. & DC.
    - a3. *Aeginetieae* Dumort.
  - b. *Orobanchoidae* Eaton
    - b1. *Gerardieae* Benth.
    - b2. *Orobancheae* Lam. & DC.
    - b3. *Escobedieae* Benth.
    - b4. *Buchneraeae* Benth.
      - b4a. *Sopubiinae* Hogg
      - b4b. *Buchnerinae* Benth. & Hook.f.
    - b5. *Cymbarieae* D. Don
    - b6. *Castillejeae* Reveal
- 455. **Thomandersiaceae** Sreem.
- 456. **Verbenaceae** J. St.-Hil.
  - a1. *Petreeae* Briq.
  - a2. *Duranteae* Benth.
  - a3. *Casselieae* Troncoso

- a4. **Citharexyleae** Briq.
- a5. **Priveae** Briq.
- a6. **Neospartoneae** Olmstead & O'Leary
- a7. **Verbeneae** Dumort.
- a8. **Lantaneae** Endl.
- 457. **Pedaliaceae** R. Br.
  - a. **Pedalioidae** Arn.
    - a1. **Sesamothamneae** Ihlenf.
    - a2. **Pedalieae** Dumort.
    - a3. **Sesameae** Dumort.
    - a4. **Dicerocaryae** Reveal
  - b. **Trapelloideae** Stapf
- 458. **Martyniaceae** Horan.
- 459. **Linderniaceae** Borsch, K.Müll. & Eb.Fisch.
  - a1. **Microcarpaeae** Miq.
  - a2. **Lindernieae** Rchb.
- 460. **Bignoniaceae** Juss.
  - a1. **Jacarandae** Seem.
  - a2. **Tourrettieae** G. Don
  - a3. **Tecomeae** Endl.
  - a4. **Bignonieae** Dumort.
  - a5. **Catalpeae** DC. ex Meisn.
  - a6. **Oroxyleae** A.H. Gentry ex Reveal & L.G. Lohmann
  - a7. **Crescentieae** G. Don
  - a8. **Coleae** Bojer ex Reveal
- 461. **Schlegeliaceae** Reveal
- 462. **Acanthaceae** Juss.
  - a. **Nelsonioideae** Pfeiff.
  - b. **Thunbergioideae** T. Anderson
    - b1. **Thunbergieae** Dumort.
    - b2. **Mendoncieae** Meisn.
  - c. **Avicennioideae** Miers
  - d. **Acanthoideae** Eaton
    - d1. **Acantheae** Dumort.
    - d2. **Ruellieae** Dumort.
    - d3. **Justicieae** Dumort.
    - d4. **Neuracanthaeae** Reveal
    - d5. **Barlerieae** Nees
    - d6. **Andrographideae** Endl.
    - d7. **Whitfieldieae** Bremek. ex Reveal
- 463. **Byblidaceae** Domin
- 464. **Lentibulariaceae** Rich.
- U. **Asteranae** Takht.
  - 86. **AQUIFOLIALES** Senft
    - 465. **Cardiopteridaceae** Blume
    - 466. **Stemonuraceae** Kårehed
    - 467. **Aquifoliaceae** Bercht. & J. Presl
    - 468. **Phyllonomaceae** Small
    - 469. **Helwingiaceae** Decne.
  - 87. **ASTERALES** Link
    - 87a. **Campanulineae** Raf.

- 470. **Rousseaceae** DC.
  - a. **Carpodetoideae** J. Lundb.
  - b. **Rousseoideae** Horan.
- 471. **Campanulaceae** Juss.
  - a. **Nemacladoideae** M.H.G. Gust.
  - b. **Campanuloideae** Burnett
    - b1. **Cyanantheae** Meisn.
    - b2. **Campanuleae** Dumort.
  - c. **Cyphioideae** Walp.
  - d. **Lobelioideae** Burnett
    - d1. **Lobeliaeae** Rchb.
    - d2. **Delisseae** C. Presl
  - e. **Cyphocarpoideae** Miers
- 87b. **Alseuosmiineae** Shipunov
- 472. **Pentaphragmataceae** J. Agardh
- 473. **Alseuosmiaceae** Airy Shaw
- 474. **Phellinaceae** Takht.
- 475. **Argophyllaceae** Takht.
- 476. **Stylidiaceae** R. Br.
  - a. **Donatioideae** Mildbr.
  - b. **Stylidioideae** Kitt.
    - b1. **Phyllachneae** Baill.
    - b2. **Stylidieae** Rchb.
- 87c. **Asterineae** Burnett
- 477. **Menyanthaceae** Dumort.
- 478. **Goodeniaceae** R. Br.
  - a. **Goodenioideae** Burnett
  - b. **Dampieroideae** Thorne & Reveal
  - c. **Brunonioideae** Burnett
- 479. **Calyceraceae** R. Br. ex Rich.
- 480. **Asteraceae** Bercht. & J. Presl
  - a. **Barnadesioideae** K. Bremer & R.K. Jansen
    - a1. **Barnadesieae** D. Don
  - b. **Stiffioideae** Panero
    - b1. **Stiftieae** D. Don
  - c. **Mutisioideae** Lindl.
    - c1. **Mutisieae** Cass.
    - c2. **Onoserideae** Solbrig
    - c3. **Nassauvieae** Cass.
  - d. **Wunderlichioideae** Panero & V.A. Funk
    - d1. **Wunderlichieae** Panero & V.A. Funk
    - d2. **Hyalideae** Panero
  - e. **Gochnatioideae** Panero & V.A. Funk
    - e1. **Gochnatieae** Rydb.
  - f. **Hecastocleioideae** Panero & V.A. Funk
    - f1. **Hecastocleaeae** Panero & V.A. Funk
  - g. **Carduoideae** Sweet
    - g1. **Dicomeae** Panero & V.A. Funk
    - g2. **Oldenburgieae** S. Ortiz
    - g3. **Tarchonantheae** Vis.
    - g4. **Cardueae** Cass.

- g4a. *Carlininae* Dumort.
- g4b. *Cardopatiinae* Less.
- g4c. *Echinopsinae* Dumort.
- g4d. *Carduinae* Dumort.
- g4e. *Centaureinae* Dumort.
- h. *Pertyoideae* Pancero & V.A. Funk
  - h1. *Pertyeae* Pancero & V.A. Funk
- i. *Gymnarrhenoideae* Pancero & V.A. Funk
  - i1. *Gymnarrheneae* Pancero & V.A. Funk
- j. *Cichorioideae* Chevall.
  - j1. *Cichorieae* Lam. & DC.
    - j1a. *Warioniinae* Gemeinholzer & H. Kilian
    - j1b. *Scorzonerinae* Dumort.
    - j1c. *Scolyminae* Less.
    - j1d. *Lactucinae* Dumort.
    - j1e. *Hyoseridinae* Less.
    - j1f. *Crepidinae* Dumort.
    - j1g. *Chondrillinae* Lamotte
    - j1h. *Hypochaeridinae* Less.
    - j1i. *Hieraciinae* Dumort.
    - j1j. *Microseridinae* Stebbins
    - j1k. *Cichoriinae* Dumort.
- j2. *Arctotideae* Cass.
  - j2a. *Arctotidinae* Dumort.
  - j2b. *Gorteriinae* Benth. & Hook.f.
- j3. *Eremothamneae* H. Rob. & Brettell
- j4. *Liabeae* Rydb.
  - j4a. *Munnoziinae* H. Rob.
  - j4b. *Liabinae* Dumort.
  - j4c. *Paranepheliinae* H. Rob.
  - j4d. *Sinclariinae* H. Rob.
- j5. *Vernonieae* Cass.
  - j5a. *Distephaninae* S.C. Kelley & H. Rob.
  - j5b. *Linziinae* S.C. Kelley & H. Rob.
  - j5c. *Gymnantheminae* H. Rob.
  - j5d. *Hesperomanniinae* S.C. Kelley & H. Rob.
  - j5e. *Centrapalinae* H. Rob.
  - j5f. *Stokesiinae* H. Rob.
  - j5g. *Leiboldiinae* H. Rob.
  - j5h. *Piptocarphinae* H. Rob., R.M. King & F. Bohlmann
  - j5i. *Elephantopinae* Less.
  - j5j. *Rolandrinae* Dumort.
  - j5k. *Pacourininae* H. Rob.
  - j5l. *Mesanthophorinae* S.C. Kelley & H. Rob.
  - j5m. *Erlangeinae* H. Rob.
  - j5n. *Lepidaploinae* S.C. Kelley & H. Rob.
  - j5o. *Centratherinae* H. Rob., R.M. King & F. Bohlmann
  - j5p. *Lychnophorinae* Benth. & Hook.f.
  - j5q. *Sipolisiinae* H. Rob.
  - j5r. *Chrestinae* H. Rob.
  - j5s. *Vernoniinae* Dumort.

- j5t. Dipterocypselinae S.C. Kelley & H. Rob.
- j5u. Trichospirinae Less.
- j6. Platycarphaeae V.A. Funk & H. Rob.
- j7. Moquinieae H. Rob.
- k. Corymbioideae Pancro & V.A. Funk
  - k1. Corymbieae Pancro & V.A. Funk
- l. Asteroideae Lindl.
  - 11. Senecioneae Cass.
    - 11a. Abrotanellinae H. Rob., G.D. Carr, R.M. King & A.M. Powell
    - 11b. Tussilaginatae Dumort.
    - 11c. Othonninae Less.
    - 11d. Senecioninae Dumort.
  - 12. Calenduleae Cass.
  - 13. Doroniceae Pancro
  - 14. Gnaphalieae Lecoq & Juill.
  - 15. Astereae Cass.
    - 15a. Amellinae Schultz-Bip.
    - 15b. Hinterhuberinae Cuatrec.
    - 15c. Brachyscominae G.L. Nesom
    - 15d. Bellidinae Willk.
    - 15e. Grangeinae Benth. & Hook.f.
    - 15f. Lageniferinae G.L. Nesom
    - 15g. Baccharidinae Less.
    - 15h. Podocomatinae G.L. Nesom
    - 15i. Asterinae Dumort.
    - 15j. Solidagininae O. Hoffm.
    - 15k. Pentachaetinae G.L. Nesom
    - 15l. Boltoniinae G.L. Nesom
    - 15m. Machaerantherinae G.L. Nesom
    - 15n. Symphyotrichinae G.L. Nesom
    - 15o. Chaetopappinae G.L. Nesom
    - 15p. Astranthiinae G.L. Nesom
    - 15q. Chrysopsidinae G.L. Nesom
    - 15r. Conyzinae Schultz-Bip.
  - 16. Anthemideae Cass.
    - 16a. Osmitopsidinae Oberpr. & Himmelnr.
    - 16b. Cotulinae Kitt.
    - 16c. Ursiniinae K. Bremer & Humphries
    - 16d. Athanasinae Pfeiff.
    - 16e. Phymaspermatae Oberpr. & Himmelnr.
    - 16f. Pentziinae Oberpr. & Himmelnr.
    - 16g. Handeliinae K. Bremer & Humphries
    - 16h. Artemisiinae Less.
    - 16i. Matricariinae Willk.
    - 16j. Anthemidinae Dumort.
    - 16k. Leucanthemopsidinae Oberpr. & Himmelnr.
    - 16l. Leucantheminae K. Bremer & Humphries
    - 16m. Santolininae Willk.
    - 16n. Glebionidinae Oberpr. & Himmelnr.
- 17. Inuleae Cass.
  - 17a. Inulinae Dumort.

- 17b. *Plucheinae* Dumort.
- 18. *Athroismeae* Pancro
  - 18a. *Athroisminae* Pancro
  - 18b. *Anisopappinae* Pancro
  - 18c. *Centipediniae* Pancro
- 19. *Feddeae* Pruski, Herrera, Anderb. & Franc.-Ort.
- 110. *Helenieae* Lindl.
  - 110a. *Heleniinae* Dumort.
  - 110b. *Tetraneuridinae* Rydb.
  - 110c. *Psathyrotinae* B.G. Baldwin
  - 110d. *Plateileminae* B.G. Baldwin
  - 110e. *Marshalliinae* H. Rob.
- 111. *Coreopsidae* Lindl.
  - 111a. *Chrysanthellinae* O. Ryding & K. Bremer
  - 111b. *Petrobiinae* Benth. & Hook.f.
  - 111c. *Coreopsidinae* Dumort.
  - 111d. *Pinillosiinae* H. Rob.
- 112. *Neurolaeneae* Rydb.
  - 112a. *Enydrinae* H. Rob.
  - 112b. *Heptanthinae* H. Rob.
  - 112c. *Neurolaeninae* Stuessy, B.L. Turner & A.M. Powell
- 113. *Tageteae* Cass.
  - 113a. *Coulterellinae* H. Rob.
  - 113b. *Varillinae* B.L. Turner & A.M. Powell
  - 113c. *Jaumeinae* Benth. & Hook.f.
  - 113d. *Flaveriinae* Less.
  - 113e. *Tagetinae* Dumort.
- 114. *Chaenactideae* B.G. Baldwin
- 115. *Bahieae* B.G. Baldwin
- 116. *Polymnieae* Pancro
- 117. *Ambrosieae* Cass.
  - 117a. *Ambrosiinae* Less.
  - 117b. *Chromolepidinae* Pancro
  - 117c. *Dugesiinae* Pancro
  - 117d. *Ecliptinae* Less.
  - 117e. *Enceliinae* Pancro
  - 117f. *Engelmanniinae* Stuessy
  - 117g. *Helianthinae* Dumort.
  - 117h. *Montanoinae* H. Rob.
  - 117i. *Rojasianthinae* Pancro
  - 117j. *Rudbeckiinae* Dumort.
  - 117k. *Spilanthinae* Pancro
  - 117l. *Verbesininae* Benth. & Hook.f.
  - 117m. *Zaluzaniinae* H. Rob.
  - 117n. *Zinniinae* Benth. & Hook.f.
- 118. *Millerieae* Lindl.
  - 118a. *Desmanthodiinae* H. Rob.
  - 118b. *Dyscritothamninae* Pancro
  - 118c. *Espeletiinae* Cuatrec.
  - 118d. *Galinsoginae* Benth. & Hook.f.

- 118e. *Guardiolinae* H. Rob.
- 118f. *Jaegeriinae* Panero
- 118g. *Melampodiinae* Less.
- 118h. *Milleriinae* Dumort.
- 119. *Madieae* Jeps.
  - 119a. *Arnicinae* B.G. Baldwin
  - 119b. *Baeriinae* Benth. & Hook.f.
  - 119c. *Hulseinae* B.G. Baldwin
  - 119d. *Madiinae* Benth. & Hook.f.
  - 119e. *Venegasinae* B.G. Baldwin
- 120. *Perityleae* B.G. Baldwin
  - 120a. *Galeaninae* Panero & B.G. Baldwin
  - 120b. *Lycapsinae* H. Rob.
  - 120c. *Peritylinae* A. Gray
- 121. *Eupatorieae* Cass.
  - 121a. *Oaxacaniinae* R.M. King & H. Rob.
  - 121b. *Hofmeisteriinae* R.M. King & H. Rob.
  - 121c. *Neomirandeiinae* R.M. King & H. Rob.
  - 121d. *Trichocoroninae* R.M. King & H. Rob.
  - 121e. *Oxylobinae* R.M. King & H. Rob.
  - 121f. *Piqueriinae* Benth. & Hook.f.
  - 121g. *Mikaniinae* R.M. King & H. Rob.
  - 121h. *Hebecliniinae* R.M. King & H. Rob.
  - 121i. *Alomiinae* Less.
  - 121j. *Ayapaninae* R.M. King & H. Rob.
  - 121k. *Adenostemmatinae* B.L. Rob.
  - 121l. *Critoniinae* R.M. King & H. Rob.
  - 121m. *Fleischmanniinae* R.M. King & H. Rob.
  - 121n. *Ageratinae* Less.
  - 121o. *Gyptidinae* R.M. King & H. Rob.
  - 121p. *Disynaphiinae* R.M. King & H. Rob.
  - 121q. *Liatridinae* Dumort.
  - 121r. *Praxelinae* R.M. King & H. Rob.
  - 121s. *Eupatoriinae* Dumort.
- 88. **ESCALLONIALES** Mart.
  - 481. **Escalloniaceae** R. Br. ex Dumort.
    - a. *Anopteroideae* Reveal
    - b. *Eremosynoideae* Dandy
    - c. *Tribeloideae* Thorne & Reveal
    - d. *Escalloniodeae* Burnett
    - e. *Polyosmoideae* Le Maout & Decne.
- 89. **BRUNIALES** Dumort.
  - 482. **Columelliaceae** D. Don
  - 483. **Desfontainiaceae** Endl. ex Pfeiff.
  - 484. **Bruniaceae** R. Br. ex DC.
    - a1. *Linconieae* Reveal
    - a2. *Audouinieae* Nied.
    - a3. *Brunieae* Rchb.
- 90. **APIALES** Nakai
  - 90a. *Aralidiinae* Thorne & Reveal
  - 485. **Pennantiaceae** J. Agardh

- 486. **Torricelliaceae** Hu
- 487. **Aralidiaceae** Philipson & B.C. Stone
- 488. **Griselinaceae** J.R. Forst. & G. Forst. ex A.Cunn.
- 489. **Pittosporaceae** R. Br.
- 90b. **Apiineae** G.M. Plunkett & Lowry
- 490. **Araliaceae** Juss.
  - a. **Aralioideae** Eaton
    - a1. **Cussonieae** Seem.
    - a2. **Meryteae** Viguier
    - a3. **Hedereae** Dumort.
    - a4. **Aralieae** Rchb.
    - a5. **Panaceae** Hook.f.
  - b. **Hydrocotyloideae** Burmeist.
- 491. **Myodocarpaceae** Doweld
- 492. **Apiaceae** Lindl.
  - a. **Mackinlayoideae** G.M. Plunkett & Lowry
    - a1. **Mackinlayeae** Hook.f.
    - a2. **Xanthosieae** Reveal
      - a2a. **Xanthosiiinae** Tausch
      - a2b. **Centellinae** Calest.
  - b. **Azorelloideae** G.M. Plunkett & Lowry
    - b1. **Mulineae** DC.
    - b2. **Azorelleae** Reveal
    - b3. **Bowlesieae** Small
  - c. **Saniculoidae** Burnett
    - c1. **Phlyctidocarpeae** Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk
    - c2. **Steganotaenieae** C.I. Calviño & S.R. Downie, Molec.
    - c3. **Saniculeae** W.D.J. Koch
  - d. **Apiodeae** Seem.
    - d1. **Lichtensteinieae** Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk
    - d2. **Marlothiellaeae** Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk
    - d3. **Choritaenieae** Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk
    - d4. **Annesorhizeae** Magee, C.I. Calviño, M. Lie, S.R. Downie, P.M. Tilney & B.-E. van Wyk
    - d5. **Heteromorpheae** M.F. Watson & S.R. Downie
    - d6. **Bupleureae** Spreng.
    - d7. **Pleurospermeae** M.F. Watson & S.R. Downie
    - d8. **Oenantheae** Dumort.
    - d9. **Smyrnieae** Spreng.
    - d10. **Aciphyllaeae** M.F. Watson & S.R. Downie
    - d11. **Scandiceae** Spreng.
      - d11a. **Daucinae** Dumort.
      - d11b. **Ferulinae** Drude
      - d11c. **Scandicinae** Tausch
      - d11d. **Torilidinae** Dumort.
    - d12. **Careae** Baill.
    - d13. **Pyramidoptereae** Boissier



- d14. **Pimpinelleae** Spreng.
- d15. **Echinophoreae** Benth. & Hook.f.
- d16. **Caucalideae** Spreng.
- d17. **Coriandreae** W.D.J. Koch
- d18. **Hohenackerieae** Calest.
- d19. **Apiaceae** Takht. ex V.M. Vinogr.
- d20. **Angeliceae** W.D.J. Koch
- d21. **Peucedaneae** Dumort.
- d22. **Tordylieae** W.D.J. Koch
- d23. **Laserpitieae** Coss. & Germ.
- d24. **Selineae** Spreng.
- 91. **PARACRYPHIALES** Takht. ex Reveal
- 493. **Paracryphiaceae** Airy Shaw
- 494. **Quintiniaceae** Doweld
- 92. **DIPSACALES** Juss. ex Bercht. & J. Presl
- 495. **Adoxaceae** E. Mey.
  - a. **Opuloideae** Raf.
    - a1. **Viburneae** O.Berg
    - a2. **Sambuceae** A. Rich. ex Duby
  - b. **Adoxoideae** Syme
- 496. **Diervillaceae** Pyck
- 497. **Caprifoliaceae** Juss.
  - a1. **Triosteae** Reveal
  - a2. **Caprifoliaceae** Dumort.
- 498. **Linnaeaceae** Backlund
- 499. **Morinaceae** Raf.
- 500. **Dipsacaceae** Juss.
- 501. **Valerianaceae** Batsch
  - a. **Triplostegioideae** Reveal
  - b. **Valerianoideae** Raf.

#### NOTES AND COMMENTS

**Acanthaceae:** In addition to the tribes noted above, Takhtajan (2009) also mentioned Aphelandreae Nees in C.F.P. von Martius, *Fl. Bras.* 9: 7, 73. 1 Jun 1847 and Lepidagathideae Bremek., *Blumea* 10: 155. 1960 (misspelled as 'Lepidagathidae').

**Aizoaceae:** Delospermeae Chesselet, G.F. Sm. & A.E. van Wyk, *Taxon* 51: 306. 2002 is assigned here to Ruschieae. The name Sesuvioideae Lindl., *Veg. Kingd.*: 527. Jan-Mai 1846 must now be replaced by Tetragonioideae.

**Alstroemeriaceae:** Stevens (2001–onward) recognized a broadly defined family accepting both Alstroemeriae Bernh., *Flora* 23: 425. 21 Jul 1840 and Luzuriageae Benth. & Hook.f., *Gen. Pl.* 3: 749, 751. 14 Apr 1883.

**Amaranthaceae:** Culham (in Heywood et al. 2007), Thorne & Reveal (2007) and Takhtajan (2009) circumscribed this family narrowly with the latter two sets of authors recognizing Polynemoideae, Gomphogynioideae and Amaranthoideae. In Chenopodiaceae, Thorne & Reveal accepted five subfamilies whereas both Culham and Takhtajan, recognized only four, assigning Suaedoideae Ulbr. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 16c: 445, 554. Jan–Apr 1934 to synonymy under Salsoloideae. Also, Betoideae is accepted here rather than assigning Beteae Volkens

in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 1a: 52, 54. 1893 to Chenopodioideae. Schäferhoff, Müller & Borsch (*Willdenowia* 39: 209–228. 2010) also recognized Chenopodiaceae in their summary of Caryophyllales.

**Anacardiaceae:** Takhtajan (2009) recognized four subfamilies while Thorne & Reveal (2007) accepted only the two given above, placing Julianioideae Takht., *Sist. Magnoliif.* [*Syst. Magnolioph.*]: 180. 24 Jun 1987 in Anacardiaceae and Pistacioideae Burnett, *Outlines Bot.*: 629, 1092, 1139. Feb 1835 in Spondiadiaceae. This reduction is also seen in Stevens (2001–onward).

**Annonaceae:** Recognition of infrafamilial taxa within this family remains unresolved and aside from the two subfamilies mentioned above (taken from Thorne & Reveal 2007), no attempt is made to distinguish tribes although several, including one validated here, seem appropriate. Takhtajan (2009) recognized several but it seems prudent at this point to mention all available names to provide the nomenclature for those engaged in exploring the family: Annoneae Endl., *Gen. Pl.*: 833. Jun 1839; Annoninae Engl. & Diels in H.G.A. Engler, *Monogr. Afr. Pflanzen-Fam.* 6: 7. Nov 1901; Asimineae Small, *Man. S.E. Fl.*: 529. 30 Nov 1933; Bocageae Endl., *Gen. Pl.*: 830. Jun 1839; Bocageioideae Pfeiff., *Nomencl. Bot.* 1(1): 427. ante 12 Jul 1872; Guatterieae Hook.f. & Thomson, *Fl. Ind.* 1: 92, 126. 1–19 Jul 1855; Hexalobeae Engl. & Diels in H.G.A. Engler, *Monogr. Afr. Pflanzen-Fam.* 6: 6. Nov 1901; Laurelieae Pax in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 2: 97. Mar 1889; Limacieae Prantl in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 2: 83. Jul 1888; Melodoreae Prantl in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 2: 28. Feb 1888; Miliuseae Hook.f. & Thomson, *Fl. Ind.* 1: 147. 1–19 Jul 1855; Miliusiinae Engl. & Diels in H.G.A. Engler, *Monogr. Afr. Pflanzen-Fam.* 6: 6. Nov 1901; Mitrephoreae Hook.f. & Thomson, *Fl. Ind.* 1: 92, 104. 1–19 Jul 1855; Mitrephorinae Engl. & Diels in H.G.A. Engler, *Monogr. Afr. Pflanzen-Fam.* 6: 6. Nov 1901; Monodoreae Baill., *Hist. Pl.* 1: 263, 288. Aug–Dec 1868; Phacanthinae Benth. & Hook.f., *Gen. Pl.* 1: 22. 7 Aug 1862; Rolliniinae Baill., *Hist. Pl.* 1: 256, 285. Aug–Dec 1868; Saccopetaleae Hook.f. & Thomson, *Fl. Ind.* 1: 92. 1–19 Jul 1855; Unoneae Benth. & Hook.f., *Gen. Pl.* 1: 21. 7 Aug 1862; Unoninae Benth. & Hook.f. in H.E. Baillon, *Hist. Pl.* 1: 264, 283. Aug–Dec 1868; Uvarieae Hook.f. & Thomson, *Fl. Ind.* 1: 91, 92. 1–19 Jul 1855; Uvariinae Benth. & Hook.f. in H.E. Baillon, *Hist. Pl.* 1: 264, 281. Aug–Dec 1868; Uvarioideae Raf., *Anal. Nat.*: 175. Apr–Jul 1815; Xylopieae Endl., *Gen. Pl.*: 831. Jun 1839; Xylopiinae Baill., *Hist. Pl.* 1: 264, 284. Aug–Dec 1868; and Xylopioideae Raf., *Anal. Nat.*: 175. Apr–Jul 1815. An oft-used name, Tetrameranthaceae R.E. Fr. ex Reveal, *Phytoneuron* 2012-37: 219. 23 Apr 2012, mentioned by Fries (in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 17A: 44, 166. 1959), is now validated (see below).

**Apocynaceae:** It is uncertain whether Allamandae G. Don, *Gen. Hist.* 4: 71, 102. 1837–8 Apr 1838 or Plumerieae E. Mey., *Comm. Pl. Afr. Austr.* 2: 188. 1–8 Jan 1838 has priority; here I have given priority to the Meyer name which can be more narrowly dated awaiting a more exact date of publication for the Don volume. The unpublished name “Rauvolfioideae” has come into use recently, but Plumerioideae Luerss. (*Handb. Syst. Bot.* 2: 1061. Nov 1882) has priority. Even so, it now seems Plumerioideae should be assigned to Carissoideae Endl. (1838) with Rauvolfieae Bartl., *Ord. Nat. Pl.*: 205. Sep 1830 placed in Vineeae Duby (1828).

**Araceae:** Takhtajan (2009) combined Pothoideae and Monsteroideae under the former and recognized Monstereae and Potheae. He also maintained Zamioculcadoideae in Philodendroideae as Zamioculcadeae. As here defined, Caladieae is circumscribed so as to include Zomicarpeae Schott, *Syn. Aroid.*: 33. Mar 1856, a name with equal priority. Takhtajan also accepted Pistiaceae and Lemnaceae as distinct families, dividing the latter into Lemnoideae and Wolffioideae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* II, 3: 163, 164. Mar 1889. Mabbetley (2007) considered Calloideae Endl., *Gen. Pl.*: 239. Jun 1837 to be distinct from Aroideae.

**Araliaceae:** The name *Cussoniaceae* is here declared to have priority over *Pterandreae* Seem., *J. Bot.* 6: 165. 1 Jun 1868, and is an earlier name for *Schefflereae* Harms in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 8: 23. 28 Dec 1894. *Mackinlayae* was retained in *Araliaceae* by Mabberley; the taxon is here assigned to *Apiaceae*.

**Areaceae:** *Livistoneae* J. Dransf., N.W. Uhl, Rasmussen, W.J. Baker, M.M. Harley & C. Lewis, *Kew Bull.* 60: 561. 2006 is included in *Trachycarpeae*. The name “*Linospadicinae*”, adopted by some, is not based on a legitimate name and John Dransfield and colleagues proposed *Laccospadicinae* as a substitute name.

**Asparagaceae:** APG III (2009) defined this family broadly whereas here the segregate families, recognized as “optional” families in APG II (2003), are retained with some modification from the expanded arrangement of Stevens (2001–onward), Takhtajan (2009), and Thorne & Reveal (2007). Details of a broadly defined *Amaryllidaceae*, *Asparagaceae* and *Xanthorrhoeaceae* are provided by Chase et al. (2009) with the subfamilies and tribes they accepted provided there with full bibliographic information.

**Balanophoraceae:** In addition to the five subfamilies recognized here, Takhtajan (2009) had two more: *Helosioideae* Tiegh., *Just's Bot. Jahresber.* 24(2): 297. 1898 (= *Seybalioidae*) and *Langsdorffioideae* Takht., *Bot. Zhurn* (Moscow & Leningrad) 75: 698. 11–30 Jun 1990 (= *Balanophoroideae*). Stevens (2001–onward) mentioned “*Lathraeophyllaceae*” seemingly as the correct name for *Helosioideae*, but no such name is known to me. Mabberley (2007) mentioned five tribes within his non-typical branch of *Balanophoraceae*; of the four Englerian subfamilies published in 1889 mentioned above, Mabberley did not select one. Names at the rank of tribe include *Dactylanthae* Benth. & Hook.f., *Gen. Pl.* 3: 233. 7 Apr 1880, *Lophophyteae* Schott & Endl., *Melet. Bot.*: 11. 1832, *Mystropteleae* Eichler in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 17: 123. 16 Oct 1873, *Sarcophyteae* Endl., *Gen. Pl.*: 73. Aug 1836, and *Heloseae* Schott & Endl., *Melet. Bot.*: 11. 1832 (including *Scybaliae* Eichler in E.P.N. Fournier, *Act. Congr. Intern. Bot.*: 152. Nov 1867).

**Basellaceae:** Takhtajan (2009) recognized two tribes: *Baselleae* Fenzl in S.F.L. Endlicher, *Gen. Pl.*: 297. Oct 1837 and *Boussingaultiae* Benth. & Hook.f., *Gen. Pl.* 3: 48. 7 Apr 1880. The latter is a later name for *Anrederae* Pfeiff., *Nomencl. Bot.* 1(1): 373. ante 12 Jul 1872.

**Berberidaceae:** Mabberley (2007) reduced *Podophylloideae* to *Berberideae*.

**Berryaceae:** APGIII (2009; see *Malvaceae*) recognized *Berryaceae* as *Brownlowioideae* Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 599, 605. 22 Jul 1926. Takhtajan (2009) assigned the taxon to *Tiliaceae* and recognized three tribes therein: *Brownlowiaceae*, *Berryaceae*, and “*Diploidsceae*”, a name that has not been validly published.

**Betulaceae:** Takhtajan (2009) recognized both *Carpinoideae* Rouy, *Fl. France* 12: 301. Nov 1910 and *Coryloideae* which are here combined with the two subfamilies recognized at the rank of tribe.

**Bignoniaceae:** The oft-recognized *Eccremocarpeae* Hogg, *Veg. Kingd.*: 526. 1858 (e.g., Mabberley 2007) is here included in *Tourrettieae*.

**Bombacaceae:** APGIII (2009; see *Malvaceae*) recognized *Bombacoideae* Burnett, *Outlines Bot.*: 816, 818, 1094, 1119. Feb 1835.

**Boraginaceae:** Mabberley (2007) maintained *Echieae* Dumort., *Fl. Belg.*: 42. 1827; here it is assigned to *Lithospermeae*. Likewise, here *Eritrichiae* Gürke in H.G.A. Engler & K.A.E. Prantl, *Nat.*

*Pflanzenfam.* IV, 3a: 81. Jun 1893 is placed in Cynoglossaceae. The generic name *Trigonotis* Steven is not legitimate, being a later name than *Endogonia* (Turcz.) Lindl. However, as the Lindley name has never been adopted, *Trigonotis* has been proposed for conservation by Cohen and Reveal (*Taxon* 60: 598–599. 2011) so as to maintain Trigonotideae.

**Brassicaceae:** In addition to the tribes mentioned above, Takhtajan (2009) also accepted the following: “Macropodieae” (=Arabiceae), Pringleae Hayek, *Beth. Bot. Zentralbl.* 27(1): 315, 329. 1911 (= Schizopetalae), “Megadeniceae”, Megacarpaeae Kamelin ex German, *Komarovia* 6: 86. 2009 (unplaced), Chamiraeae Sond., *Abh. Naturwiss. Naturwiss. Verein Hamburg* 1: 267. 1846 (unplaced but perhaps Heliophila); “Stenopetalae” (an invalid name, =Camelineae), and “Lyrocarpiceae” (=Physariceae).

**Bromeliaceae:** Takhtajan (2009) retained three tribes in Pitcairnioideae, namely Brocchiniae G.S. Varad. & Gilmartin, *Syst. Bot.* 13: 295. 19 Apr 1988, Pitcairniae Meisn., *Pl. Vasc. Gen.: Tab. Diagn.* 395, Comm. 298. 17–20 Aug 1842, and Puyae Beer, *Fam. Bromel.*: 9, 19. Sep–Oct 1856.

**Burseraceae:** As here defined, Canariaceae includes Garugeae Marchand, *Adansonia* 8: 66. Nov 1867.

**Buxaceae:** Takhtajan (2009) recognized four tribes, the three mentioned here and Buxae Dumort., *Anal. Fam. Pl.*: 45. 1829. Stevens (2001–onward) recognized only Stylocerateae (as “Sarcococceae”) and Buxae. The recently proposed name, Styloceratoideae Thorne & Reveal, *Bot. Rev.* (Lancaster) 73: 89. 29 Jun 2007, is a taxonomic synonym of the overlooked Pachysandroideae.

**Byttneriaceae:** APGIII (2009; see Malvaceae) recognized Byttnerioideae Burnett, *Outlines Bot.*: 821, 1119. Feb 1835. Takhtajan (2009) retained the subfamily in his Sterculiaceae and recognized eight tribes: Lasiopetalae, Hermanniae, “Helmiopsidae”, Byttneriae, and Theobromatae (as “Theobromae”); these are here assigned to Byttneriaceae. As for Helicterae (misspelled as “Helicetereae”), Eriolaeneae, and “Triplachitoniae” (for which the name Mansonieae is available), are assigned here to Helicteraceae. Fremontodendreae Airy Shaw, *Kew Bull.* 18: 257. 8 Dec 1965 (a later name for Chiranthodendreae) is here assigned to Bombacaceae.

**Cactaceae:** Mabberley (2007) and Takhtajan (2009) recognized Echinocereae Buxb., *Madroño* 14: 193. 2 May 1958, which is assigned here to Pachycereae. Echinopsidae K. Friedrich & G.D. Rowley, *Repert. Pl. Succ. (I.O.S.)* 25: 6. 1976 is included in Trichocereae and Monvilleae F. Ritter, *Kakteen Südamerika* 1: 230. 1979 in Cereae; both were unnecessarily proposed as new names for Trichocereae and Cereae respectively. The name Maihueinae Doweld, *Sukkulenty* 1(2): 25. 25 Jul 1999 is available whereas the invalid “Calymanthiae” is now termed Lymanbensoniae. No attempt has been made to account for the numerous subtribes that have been proposed for this family.

**Campanulaceae:** Takhtajan (2009) recognized eight subfamilies. In addition to the five accepted above, he recognized Cyananthoideae Takht. ex Reveal, *Phytoneuron* 2012-33: 2. 9 Apr 2012, Canarinoideae Kolak., *Bot. Zhurn.* (Moscow & Leningrad) 72: 1574. Dec 1987, and Ostrowskioideae Takht., *Divers. Classif. Fl. Pl.*: 408. 24 Apr 1997; all are included here in Campanuloideae. Under Cyananthoideae, Takhtajan accepted Cyanantheae, “Codonopsidae”, and Platycodoneae Yeo, *Taxon* 42: 109. 12 Feb 1993. In Campanuloideae he recognized Wahlenbergiae Endl., *Gen. Pl.*: 514. Jun 1838, Azorineae Kolak., *Bot. Zhurn.* (Moscow & Leningrad) 72: 1575. Dec 1987, Echinocodoneae Kolak., *Bot. Zhurn.* (Moscow & Leningrad) 79(1): 114. 72: 1575. Dec 1987 (misspelled “Echinocodoneae”), Peracarpeae Fed., *Fl. URSS* 24: 471. 1957, Phyteumateae Dumort., *Fl. Belg.*: 59. 1827, Edraiantheae Fed., *Fl. URSS* 24: 475. 1957, Jasioneae Dumort., *Fl. Belg.*: 59. 1827, Prismatocarpeae Lindl. ex Pfeiffer, *Nomencl. Bot.* 2: 839. Dec 1872, “Siphocodoneae”, and Merciereae Meisn., *Pl. Vasc. Gen.: Tab. Diagn.* 238, 242, Comm. 150. 18–24 Aug 1839. Future work

will undoubtedly show that some of these tribes are worthy of recognition, although most perhaps more appropriately at the rank of subtribe.

**Capparaceae:** Takhtajan (2009) placed Stixaceae Hallier, *Beih. Bot. Centralbl.* 39: 35. 15 Dec 1921 and Hutchinson's (*Gen. Fl. Pl.*: 305, 316. 1967) invalid "Apophylleae" in this family; these genera are treated here in Stixaceae.

**Caprifoliaceae:** APG III (2009) defined Caprifoliaceae broadly so as to include Diervillaceae, Dipsacaceae, Linnaeaceae, Morinaceae, and Valerianaceae. If such a view is taken all of these families could be recognized at the rank of subfamily for which the following names are available: Diervilloideae Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 82. Oct–Dec 1820, Dipsacoideae Eaton, *Bot. Dict.*, ed. 4: 36. Apr–Mai 1836, Linnaeoidae Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 83. Oct–Dec 1820, Morinoideae Burnett, *Outlines Bot.*: 918. Feb 1835, and Valerianoideae.

**Caryophyllaceae:** Takhtajan (2009) recognized three subfamilies, each subdivided into tribes. In addition to the tribes mentioned above, Takhtajan also accepted: Telephieae DC., *Prodr.* 3: 366. medio Mar 1828, Xerotiace Pax, *Bot. Jahrb. Syst.* 61: 231. 15 Jun 1927, Pycnophylleae Mattf., *Repert. Spec. Nov. Regni Veg.* 18: 167. 1922, Geocarpeae E.J. Palmer & Steyerl., *Bull. Torrey Bot. Club* 77: 272. 1950, Habrosieae Endl., *Gen. Pl. Suppl.* 3: 91. Oct 1843, and Drypideae Fenzl in S.F.L. Endlicher, *Gen. Pl.*: 974. 1–14 Feb 1840. Mabberley (2007) maintained Paronychioideae A.St.-Hil. ex Fenzl in S.F.L. Endlicher, *Gen. Pl.*: 956. Nov 1839 rather than the nomenclaturally correct Illecebroideae. Likewise, Mabberley subdivided Caryophylloideae, as outlined here, into Alsinoideae Burnett, *Outlines Bot.*: 807, 1094, 1117. Feb 1835 wherein he assigned Pycnophylleae, Geocarpeae, Habrosieae, and Scleranthaceae; the first three are reduced here to Scleranthaceae whereas in the present treatment a distinction is made between Alsineae and Arenarieae, the latter being assigned to the former by Mabberley.

**Celastraceae:** Takhtajan (2009) recognized Pottingerioideae Airy Shaw, *Kew Bull.* 28: 100 1973, a taxon here recognized at the family level, adopting Airy Shaw's original conclusion that the family is allied with Celastraceae. Unlike Stevens (2001–onward) and APG III (2009), Parnassiaceae is maintained at the family rank. Resolution of the tribal taxonomy for Celastraceae is not yet at hand. The following names are available: Brexiace Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 67, Comm. 48. 21–27 Mai 1837, Cassineae G. Don, *Gen. Hist.* 2: 2, 12. Oct 1832, Celastreae Rchb., *Handb. Nat. Pfl.-Syst.*: 301. 1–7 Oct 1837, Elaeodendreae Endl., *Gen. Pl.*: 1087. Apr 1840, Euonymaceae DC., *Prodr.* 2: 3. medio Nov 1825, Hippocrateae Rchb., *Handb. Nat. Pfl.-Syst.*: 301. 1–7 Oct 1837, Lophopetalae Loes. ex Reveal, *Phytoneuron* 2012-37: 217. 23 Apr 2012, Perrottetiae Loes. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 5: 214, 220. Dec 1892, Rhacomeae Small, *Man. S.E. Fl.*: 817. 30 Nov 1933, Stackhousiae Baill., *Hist. Pl.* 6: 22, 43. Jan–Apr 1875, Tonteleae Miers, *Trans. Linn. Soc. London* 28: 330. 8 Jun 1872, and Tripterygieae Kuntze in T.E. von Post & C.E.O. Kuntze, *Lex. Gen. Phan.*: 662. 20–30 Nov 1903. Takhtajan recognized Euonymaceae, Celastreae, Lophopetalae, Cassineae (including Elaeodendreae), and Perrottetiae in his Celastroideae. Tripterygieae was included in Tripterygioideae Loes. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 5: 199, 212. Dec 1892 (a subfamily here retained in Celastroideae). Takhtajan defined Hippocrateoideae to include "Salaciaceae" (for which the name Tonteleae probably has priority), two invalid names, "Campylostemoaceae" and "Helictonemaceae", and Hippocrateae. Within his Stackhousiaceae, Takhtajan recognized "Macgregorioideae" and Stackhousioideae. The name "Campylostemoideae", which is often cited in the literature, is not validly published.

**Celtidaceae:** This family is often included within Ulmaceae as Celtidoideae A. Rich. ex Darl., *Agric. Bot.*: 151. 1847.

**Centropaceae:** Takhtajan (2009) included the taxon in Pandaceae as Centropaceae Radcl.-Sm., *Gen. Euphorb.*: 78. 2001.

**Cistaceae:** Takhtajan (2009) recognized three tribes: Cistaceae Rchb., *Fl. Germ. Excurs.* 2(2): 710, 711. 1832, Hudsoniaceae Janch. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 21: 301. 30 Jul 1925, and Lecheaceae Spach, *Ann. Sci. Nat. Bot.*, sér. 2, 6: 371. Dec 1836. Also available is Fumaneae Willk. in H.M. Willkomm & J.M.C. Lange, *Prodr. Fl. Hispan.* 3: 706. Apr–Mai 1880.

**Cleomeae:** Takhtajan (2009) recognized three tribes in Cleomoideae: Cleomeae DC., *Prodr.* 1: 237. medio Jan 1824, “Oxystylidae”, and “Podandrogyneae”.

**Clusiaceae:** Takhtajan (2009) recognized four subfamilies with two further subdivided into tribes. Stevens (2001–onward), as here, recognized Calophylloideae Burnett, *Outlines Bot.*: 794, 1114. Feb 1835 at the rank of family. Takhtajan recognized two tribes in his Calophylloideae: Calophylleae (including Kilmeyeroideae) and Endodesmiae. The other adopted subfamilies were Clusioidae, Moronoboidae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 6: 205. 7 Nov 1893 (a later name for Chrysopioideae), and Lorostemonoideae with the first subdivided into two tribes: Clusiaceae and Garcinieae. Thorne & Reveal (2007) retained both Calophyllaceae and Hypericaceae in Clusiaceae, the latter as Hypericoideae Choisy in A.P. de Candolle, *Prodr.* 1: 541. medio Jan 1824. In addition, Thorne & Reveal recognized Kilmeyeroideae Engl. in C.F.P. von Martius, *Fl. Bras.* 12(1): 391–392. 1 Apr 1878. As done by Takhtajan, three tribes are recognized here but in Calophyllaceae rather than Calophylloideae. Mabberley (2007) broadly defined Clusiaceae under the name Guttiferae, adopting “Bonnetioideae”, an invalid name that, if proposed, would be a synonym of Kilmeyeroideae. The name Chrysopioideae (1835) has priority over Symphonioideae Luerss., *Handb. Syst. Bot.* 2: 648. Jun 1881, and Symphonioideae Choisy in A.P. de Candolle, *Prodr.* 1: 563. medio Jan 1824 has priority over Moronobaceae Endl., *Gen. Pl.*: 1026. 1–14 Feb 1840, although the latter was adopted (as “Moronobaceae”) by Mabberley.

**Colchicaceae:** Takhtajan (2009) recognized two additional tribes: Streptoaceae Baker, *J. Linn. Soc. London, Bot.* 14: 522. 24 Apr 1875 and Gloriosoaceae Baill., *Hist. Pl.* 12: 484, 583. Apr 1894. Takhtajan used the name “Wurmbeaceae” instead of the validly published Anguillaraceae. Gloriosoaceae is considered here to be a synonym of Colchicaceae, and the tribe Streptoaceae, and Takhtajan’s family Scoliopaceae, here are placed in Liliaceae as Streptopioideae.

**Convolvulaceae:** Mabberley (2007) recognized Cardiochlamyaeae Stefanović & D.F. Austin in S. Stefanović, D.F. Austin & R.G. Olmstead, *Syst. Bot.* 28: 796. 13 Nov. 2003; it is here considered a synonym of Poraneae.

**Crassulaceae:** As here defined, Umbilicaceae includes all of the “Thelipheum clade.” Use of the name “Thelipheae” by various authors is not correct nomenclaturally as the name was not based on an included genus. Various authors have also used “Echeverieae”, a name, to my knowledge, yet to be validly published.

**Cucurbitaceae:** Takhtajan (2009) adopted the 2005 classification of the family proposed by Jeffrey recognizing several more tribes than recorded above. Thus he (as well as Mabberley 2007) used the later Nhandiroboideae A.St.-Hil. ex Voigt, *Hort. Suburb. Calcutt.*: 51. Aug–Dec 1845 instead of Fevilleioideae Burnett, *Outlines Bot.*: 756, 1092, 1129. Feb 1835 to go along with Cucurbitoidae Eaton, *Bot. Dict.*, ed. 4: 47. Apr–Mai 1836. Joliffieae is an earlier name for Telfairiaceae Arn., *J. Bot. (Hooker)* 3: 273. Feb 1841, and Cyclantheraceae Schrad., *Linnaea* 12: 408. Apr–Sep 1838 is here treated as a synonym of Sicyoeae. Among the validly published names not accounted for above but used by Takhtajan are Trichosantheae C. Jeffrey, *Kew Bull.* 15: 341. 19 Mar 1962 (= Sicyoeae),

Herpetospermeae C. Jeffrey, *Bot. Zhurn.* (Moscow & Leningrad) 90: 333. 13 Apr 2005 (= Schizopepomeae), and Luffinae C. Jeffrey, *Kew Bull.* 15: 340. 19 Mar 1962 (= Sicyoeae).

**Cyperaceae:** Mabberley (2007) divided the family into four subfamilies, adding Caricoideae Beilschm., *Flora* 16(Beibl. 7): 52, 105. 14 Jun 1833 and Sclerioideae Beilschm., *Flora* 16(Beibl. 7): 52, 110. 14 Jun 1833. In the latter he assigned Bisboeckelerae, Cryptangiae, Scleriae, and Trilepidae.

**Dilleniaceae:** Takhtajan (2009) recognized two tribes which he assigned to Dilleniaceae: Dilleniaceae DC., *Syst. Nat.* 1: 397, 411. 1–15 Nov 1817 and Hibbertiaceae Spach, *Hist. Nat. Vég.* 7: 413, 419. 4 Mai 1838. The latter is treated here as a subfamily.

**Dipterocarpaceae:** Takhtajan (2009) recognized four subfamilies, the three recognized above and the invalid “Pseudomonotoideae” which here is included in Monotoideae. In Dipterocarpoideae, Takhtajan recognized “Parashoreae” and Dryobalanopseae Baill., *Hist. Pl.* 4: 210, 213. 1872 (misspelled Dryobalaneeae), both are included in Shoreaeae.

**Dombeyaceae:** APGIII (2009; see Malvaceae) recognized Dombeyoideae Beilschm., *Flora* 16(Beibl. 7): 86, 106. 14 Jun 1833. Takhtajan (2009) retained the subfamily in his Sterculiaceae. Cheek in Heywood et al. (2007) used Pentapetaceae, but Dombeyaceae is now a conserved name so it has priority.

**Elaeocarpaceae:** APGIII (2009) and Stevens (2001–onward) include Tremandraceae in Elaeocarpaceae. If done, two names at the rank of subfamily would be appropriate although presently only Elaeocarpoideae Arn., *Botany*: 100. 9 Mar 1832 is available.

**Ericaceae:** Takhtajan (2009) recognized three additional subfamilies beyond those cited above: Pyroloideae Beilschm., *Flora* 16(Beibl. 7): 72, 109. 14 Jun 1833, “Epigaceoideae”, and Rhododendroideae Sweet, *Brit. Fl. Gard.* 3: 263. Aug 1828. Here the first is included within Monotropoideae and the latter two are retained in a broadly defined Ericoideae. Takhtajan also recognized several additional tribes: Pleuricosporae A. Gray, *Proc. Amer. Acad. Arts* 7: 370. Jul 1868 and Hemitomeae Domin, *Fichtenspargel*: 101. 25 Feb 1915 (Monotropoideae); Callunae Klotzsch, *Monatsber. Königl. Preuss. Akad. Wiss. Berlin* 1857: 3. Jan 1857 (Ericoideae); Rhododendreae Colla, *Herb. Pedem.* 4: 82. 15–31 Aug 1835, Cladothamneae Copel., *Amer. Midl. Naturalist* 30: 548. 1943, Daboeciae Kuntze in T.E. von Post & C.E.O. Kuntze, *Lex. Gen. Phan.*: 679. 20–30 Nov 1903, and Diplarchae Airy Shaw, *Kew Bull.* 17: 508. 1964 (Rhododendroideae). The earlier Styphelioideae Sweet, *Fl. Australas.*: ad t. 47. 1 Mai 1828 must now fall into synonymy under Epacridoideae (Reveal 2012) while Stypheliaceae Bartl., *Ord. Nat. Pl.*: 158. Sep 1830 remains a later name for Stenanthereae. With recognition of Bryantheae, the long-recognized Bejaricieae Copel., *Amer. Midl. Naturalist* 30: 547. 1943, is now assigned to synonymy under Phyllodoceae.

**Escalloniaceae:** Takhtajan (2009) recognized Anopteraceae, Eremosynaceae, and Tribelaceae, whereas here all are retained in Escalloniaceae. As for Escalloniaceae he further subdivided that into Forgesieae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 18a: 111. 3 Mai 1930, Escalloniaceae R. Br. ex DC., *Prodr.* 4: 2. late Sep 1830, and “Polyosmeae” along with Anopteraceae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 18a: 110. 3 Mai 1930. The latter two tribes are here retained at the rank of subfamily. Baillon (Adansonia 12: 337. 1880) proposed the unranked “Polyosmées” and gave a description in French; the orthography was corrected by Koehne (*Just's Bot. Jahresbr.* 6(2): 528. 1883) but the name was still unranked. I am not aware of the name being validated formally at the rank of tribe.

**Euphorbiaceae:** The name Plukenetiae Hutch., *Amer. J. Bot.* 56: 753. Aug 1969, is a synonym of Dalechampiaceae, the former being adopted by Takhtajan (2009). I am grateful for the help I received from Dr. Kenneth Wurdack (US) in resolving the nomenclature in this and its related families.

**Fabaceae:** In addition to the tribes mentioned above, Takhtajan (2009) recognized Adesmieae Hutch., *Gen. Fl. Pl.* 1: 466. 3 Dec 1964, Aeschynomeneae Hutch., *Gen. Fl. Pl.* 1: 470. 3 Dec 1964, Carmichaeliae Hutch., *Gen. Fl. Pl.* 1: 372. 3 Dec 1964, and Viciae DC., *Prodr.* 2: 353. medio Nov 1825, the latter a synonym of the required name Fabaeae.

**Fagaceae:** Stevens (2001–onward) presented evidence which suggested that recognition of four subfamilies, as done here (following Thorne & Reveal 2007 and Takhtajan 2009), might be better treated as just two subfamilies Querceoideae and a monogeneric Fagoideae. In that case the names Castaneae Dumort., *Fl. Belg.*: 15. 1827, Querceae Dumort., *Fl. Belg.*: 15. 1827 and Trigonobalanaceae Menitsky, *Duby Aziz*: 13. 1984 are available for a more broadly defined Querceoideae.

**Gesneriaceae:** Takhtajan (2009) recognized additional tribes: Bellonieae Fritsch in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3b: 143. Mai 1893, Championieae Fritsch in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3b: 143. Mai 1893, Ramondeae Fritsch in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3b: 143, 144. Mai 1893, and Streptocarpeae Fritsch in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3b: 142. Mai 1893. Mabberley (2007) accepted Coronantheroideae Wiehler, *Selbyana* 6: 156. 31 Aug 1983, here assigned to Gesnerioideae. The type of the tribe Titanotricheae T.Yamaz. ex W.T. Wang, *Fl. Republ. Popularis Sin.* 69: 577. 1990, sometimes referred to Gesneriaceae, is placed here in Rehmanniaceae (Reveal 2011).

**Hyacinthaceae:** APG III (2009) assigned this family to a broadly defined Asparagaceae which was subsequently parsed by Chase et al. (2009) into subfamilies and tribes. Here, a more narrowly defined Asparagaceae is maintained akin to that suggested by APG II (2003) and, where appropriate, the subfamilies and tribes also are maintained. Pellmyr (*Ann. Missouri Bot. Gard.* 90: 35–55. 2003), Seberg (in Heywood et al. 2009), and Shipunov (2012) have mentioned “Camassiaceae”, an unpublished name seemingly first suggested in passing by Chupov (*Bot. Zhurn.* (Moscow & Leningrad) 79(3): 7. Mar–Sep 1994), but instead of placing *Camassia* in Hyacinthaceae, that taxon is here assigned to Agavaceae. If one were to use a family name then Chlorogalaceae is available.

**Hydrangeaceae:** Takhtajan (2009) recognized three subfamilies, Hydrangeoideae, Philadelphoideae Burnett, *Outlines Bot.*: 732, 1092, 1135. Feb 1835 and Kirengeshomoideae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 18a: 109, 3 Mai 1930; the latter is recognized here as a subtribe of Philadelphaeae.

**Hydrocharitaceae:** In addition to the subfamilies recognized above, Takhtajan (2009) also accepted Thalassioideae Asch. & Gürke in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* II, 1: 247. Mar 1889; the members of this subfamily are assigned here to Halophileae. The name Najadoideae is now mandated over Hydrilloideae Luerss., *Handb. Syst. Bot.* 2: 308. Dec 1879 (Reveal 2012).

**Icacinaeae:** The tribal classification is unsettled and what is given above is just an alphabetical listing of those units seemingly worthy of recognition and does not reflect their linear relationships. In addition to these, Takhtajan (2009) also recognized “Discophoreae” and “Metteniusae”, the latter here recognized as Metteniusaceae.

**Iridaceae:** Both Mabberley (2005) and Takhtajan (2009) recognized most of the above mentioned tribes but adopted an effectively published but not legitimate name Maricieae Hutch. (*Fam. Fl. Pl.*: 239. 1934) instead of the nomenclaturally correct Trimezieae. Pillansiae Goldblatt, *Ann. Missouri*



*Bot. Gard.* 77: 621. 16 Nov 1990, is now considered a synonym of Watsoniaceae. Ixiceae has priority over Croceae Dumort., *Fl. Belg.*: 137. 1827, the latter being used by Goldblatt and Manning (Iris Family: 14, 85, 113, 186, 284. 2008).

**Juglandaceae:** Takhtajan (2009) recognized two tribes in Juglandoideae as suggested here but adopted Hicoriae W.E. Manning, *Ann. Missouri Bot. Gard.* 65: 1079. 1979, a later name for Caryaceae.

**Lamiaceae:** Takhtajan (2009) recognized Symphoremataceae as distinct from Lamiaceae and retained, as done traditionally, Viticoideae in Verbenaceae. The tribal classification adopted here, and followed by most recent authors, is based largely on that of Harley et al. (in K. Kubitzki, ed., *Fam. Gen. Fl. Pl.* 7: 167–275. 2004). However, Pogostemonoideae P.D. Cantino, Harley & S.J. Wagstaff in R.M. Harley & T. Reynolds (eds.), *Adv. Labiate Sci.*: 512. Nov 1992 is retained within Lamiaceae. Both Menthaeae and Nepeteae Dumort., *Fl. Belg.*: 47. 1827 were proposed in 1827; Menthaeae is adopted here following Harley et al. but this is almost certainly not correct nomenclaturally (e.g., see Wegelin, *Enum. Stirp. Fl. Helv.*: 29. 1838 who assigned *Mentha* to Nepeteae); also Clinopodiinae has priority over the name Menthinae Endl., *Gen. Pl.*: 612. Aug 1838 adopted by Harley et al. Takhtajan recognized Glechoneae Engl., *Syllabus*, ed. 1: 164. Apr 1892, Salviaeae Dumort., *Fl. Belg.*: 43. 1827, Rosmarinae K. Schum., *Lehrb. Syst. Bot.*: 486. Jun 1894, and Catopheriae Kuntze in T.E. von Post & C.E.O. Kuntze, *Lex. Gen. Phan.*: 690. 20–30 Nov 1903, all here assigned to Menthaeae. In addition, Lavanduleae Caruel in F. Parlatore, *Fl. Ital.* 6: 53. Sep 1884 is here retained in Ocimeae. Placement of Callicarpeae and Tectoneae in Caryopteridoideae seems reasonable given the current lack of resolution among the basal members of the family, but if assigned to Viticoideae, then Viticeae Bartl., *Ord. Nat. Pl.*: 180. Sep 1830, is available.

**Lardizabalaceae:** Takhtajan (2009) recognized three tribes: Sinofranchetiae Loconte & J.R. Estes, *Syst. Bot.* 14: 575. 11 Oct 1989, Stauntoniae H.N. Qin & Y.C. Tang, *Cathaya* 1: 80. Oct 1989, and Lardizabaleae, although the name Akebieae has priority over Stauntoniae. Thorne & Reveal also recognized Decaisneioideae Loconte & J.R. Estes, *Syst. Bot.* 14: 574. 11 Oct 1989.

**Lauraceae:** Recognition of two subfamilies, as done by Thorne & Reveal (2007) and by Takhtajan (2009), seems justified, with the majority of tribes assigned to Cassythoideae rather than Lauroideae. If the unplaced Cinnamomeae Nees, *Syst. Laur.*: 19, 28bis, 29. 30 Oct–5 Nov 1836 proves to be a member of Lauroideae, then Laureae Le Maout & Decne., *Traité Général Bot.*: 461. Jan–Apr 1868 is available. None of the new suprageneric names proposed by Kostermans (*Reinwardtia* 4: 193–256. 1957) is validly published.

**Lecythidaceae:** Most authors recognized Planchonioideae Engl., *Syllabus*, ed. 1: 146. Apr 1892 instead of the nomenclaturally correct Barringtonioideae adopted here and by Thorne & Reveal (2007). The nomenclaturally correct name, Asteranthoideae, was recently proposed (Reveal 2012); it replaces Foetidoideae Engl., *Syllabus*, ed. 1: 146. Apr 1892. Only Lecythidoideae is subdivided by Takhtajan into tribes: Griadeae Pichon, *Notul. Syst.* 12: 3–4. 1946, Couroupiteae Pichon, *Notul. Syst.* 12: 3–4. 1946, Lecythideae DC. in D.F.L. von Schlechtendal, *Linnaea* 2: 505. Jul 1827, Couratariaeae Pichon, *Notul. Syst.* 12: 3–4. 1946, and Bertholetiae Pichon, *Notul. Syst.* 12: 3–4. 1946. Final resolution of the tribal classification is being worked on presently by Scott A. Mori (NY).

**Liliaceae:** In addition to the two tribes mentioned above, Takhtajan (2009) also recognized “Lloydieae” which is included here in Liliaceae seemingly unaware that Lloydiniaceae S. Watson, *Proc. Amer. Acad. Arts* 14: 220. 2 Aug 1879 (*Lloydieae*) was proposed as a lower rank.

**Loasaceae** : In addition to the taxa accepted above, Takhtajan (2009) also recognized Kissenieae Gilg in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 6a: 107, 113. 27 Feb 1894 which here is retained in Loasaceae.

**Loganiaceae**: Mabberley (2007) defined the family broadly, recognizing seven tribes that are included here in other families: Plocospermateae Lecuwenberg, *Acta Bot. Néerl.* 16(2): 57. 1967 (misspelled “Plocospermeae” = Plocospermateaceae), Gelsemieae G. Don, *Gen. Hist.* 4: 70, 87. 1837–8 Apr 1838 (= Gelsemiaceae), Buddlejeae (= Scrophulariaceae), Retzieae (= Stilbaceae), Potalieae (= Gentianaceae), and Desfontainieae G. Don, *Gen. Hist.* 4: 175, 213. 1837–8 Apr 1838 (= Desfontainiaceae).

**Lythraceae**: Takhtajan (2009) recognized two additional subfamilies, Duabangoideae S.A. Graham, Thorne & Reveal, *Taxon* 47: 436. 15 Mar 1998 and Sonneratioidae S.A. Graham, Thorne & Reveal, *Taxon* 47: 436. 15 Mar 1998; both are referred here to Lagerstroemioidae. In addition the following tribes were also accepted by Takhtajan: Lythrae Dumort., *Anal. Fam. Pl.*: 39. 1829, Nesaeeae Koehne, *Bot. Jahrb. Syst.* 1: 144. 30 Jul 1880, and Lagerstroemieae DC., *Prodr.* 3: 92. medio Mar 1828.

**Magnoliaceae**: Takhtajan (2009) recognized two tribes within Magnolioideae: Magnolieae DC., *Prodr.* 1: 79. medio Jan 1824 and Michelieae Y.W. Law, *Acta Phytotax. Sin.* 22: 106. Apr 1984.

**Malesherbiaceae**: Stevens (2001–onward) and APGIII (2009) assigned this family to Passifloraceae as Malesherbioideae Burnett, *Outlines Bot.*: 750, 1092, 1129. Feb 1835.

**Malpighiaceae**: Takhtajan (2009) recognized three subfamilies. In addition to Malpighioideae, he also accepted “Hiraeoideae” and Gaudichaudioideae C.V. Morton, *Taxon* 17: 318. 18 Jun 1968. The former name has been used off and on in the literature since mentioned by Scholz in Melchior’s 1964 *Syllabus*, but the name has yet to be validly published.

**Malvaceae**: Stevens (2001–onward), APG II 2003; APG III 2009, Mabberley (2007) and others have adopted the expansion of Malvaceae generally with the following subfamilies recognized: Bombacoideae Burnett, *Outlines Bot.*: 816, 818, 1094, 1119. Feb 1835; Brownlowioideae Burnett, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 599, 605. 22 Jul 1926; Byttnerioideae Burnett, *Outlines Bot.*: 821, 1119. Feb 1835; Dombeyoideae Beilschm., *Flora* 16(Beibl. 7): 86, 106. 14 Jun 1833; Grewioideae Dippel, *Handb. Laubholz.* 3: 56. Oct–Nov 1893; Helicteroideae Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 29, Comm. 25. 26 Mar–1 Apr 1837; Malvoideae Burnett, *Outlines Bot.*: 816, 1094, 1118. Feb 1835; Sterculioideae Beilschm., *Flora* 16(Beibl. 7): 86. 14 Jun 1833; and Tilioideae Arn., *Botany*: 100. 9 Mar 1832. Cheek (in Heywood 2007) rejected this arrangement and recognized ten families. This latter opinion is largely followed here with some correction as to the nomenclature (see Malvaceae, p. 58).

**Melastomataceae**: Some authors recognize, at the rank of tribe, the subtribes here assigned to Melastomateae: Blakeae Benth. & Hook.f., *Gen. Pl.* 1: 727, 735. Sep 1867, Merianieae Triana, *Bull. Cong. Int. Bot. Hort Amsterdam* 1865: 457. 1866, Miconieae DC., *Prodr.* 3: 152. medio Mar 1828, Microlicieae Naudin, *Ann. Sci. Nat. Bot.*, sér. 3, 12: 203. Oct 1849, and Rhexieae DC., *Prodr.* 3: 114. medio Mar 1828.

**Meliaceae**: Takhtajan (2009) recognized four subfamilies with Quivisianthoideae T.D. Penn. & Styles, *Blumea* 22: 508. 24 Sep 1975 here assigned to Melioideae and Capuronianthoideae T.D. Penn. & Styles, *Blumea* 22: 509. 24 Sep 1975 placed in Cedreloideae. As noted by Thorne & Reveal

(2007), Cedreloideae is an earlier name for the commonly used Swietenioideae Lucruss., *Hand. Syst. Bot.* 2: 693, Jun 1881.

**Menispermaceae:** Mabberley (2007) and Culham (in Heywood et al. 2007) adopted Fibraureaceae Diels in H.G.A. Engler, *Nat. Pflanzenz.* 46: 46, 115. 6 Dec 1910 (misspelled as Fibraureae) instead of the earlier Coscinaceae.

**Myricaceae:** Takhtajan (2009) recognized two subfamilies, only one of which has been validly published: “Canamycrinoideae” and Myrcioideae Kausel, *Lilloa* 32: 346, Jun 1967.

**Nyctaginaceae:** Other available names allied to Nyctagineae at the rank of tribe are: Abroniceae S. Watson in W.H. Brewer et al., *Bot. California* 2: 1. 1880, Acleisantheae S. Watson in W.H. Brewer et al., *Bot. California* 2: 2. 1880, Allionieae Rehb., *Handb. Nat. Pfl.-Syst.*: 174. 1–7 Oct 1837 (an earlier name for Abroniceae), Phaeoptilinae Heimerl in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 16c: 106, 123. Jan–Apr 1934, and Pisonieae Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 318, Comm. 230. 18–24 Jul 1841.

**Nymphaeaceae:** Thorne & Reveal (2007) recognized four subfamilies, but both Heywood (in Heywood et al. 2007) and Stevens (2001–onward), like here, accept only two with both Barclayoideae Weberb., *Bot. Jahrb. Syst.* 18: 248. 13 Apr 1894 and Euryaloideae Thorne, *Aliso* 8: 194. 9 Sep 1974 included in Nymphaeoideae. Takhtajan (2009) retained Cabombaceae as distinct and mentioned Ondineae Tamura, *Acta Phytotax. Geobot.* 33: 344. 1982.

**Ochnaceae:** Takhtajan (2009) retained Sauvagesiaceae which he subdivided into two subfamilies: Sauvagesioideae and Euthemidoideae Planch. ex Endl., *Gen. Pl. Suppl.* 5: 99. 1850; here both are reduced to the rank of tribe within Sauvagesioideae and retained in Ochnaceae. Thorne & Reveal (2009) did not accept Luxemburgioideae. Stevens (2001–onward) recognized the three subfamilies at the rank of tribe, adding the name Luxemburgieae Horan., *Char. Ess. Fam.*: 180. 17 Jun 1847. Takhtajan also accepted Lophiraceae.

**Olacaceae:** Takhtajan (2009) defined this family more broadly than seen above, assigning Erythralaceae and Schoepfiaceae to Olacaceae, the latter as Schoepfiaceae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam. Nachtr.*: 145. 2 Aug 1897. Within his Anacoloideae Sleumer ex Reveal, *Phytoneuron* 2012–37: 215. 23 Apr 2012, he recognized four tribes: Couleae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam. Nachtr.*: 145, 149. 2 Aug 1897, Heisterieae Dumort., *Anal. Fam. Pl.*: 47. 1829, Ximenieae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam. Nachtr.*: 145, 147. 2 Aug 1897, and Anacoloideae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 1: 233, 234. Mai 1889. Thorne & Reveal (2007) also defined Olacaceae broadly, recognizing both Octoknemoideae and Erythraloideae along with Olacaceae. Stevens (2001–online) largely rejected the newly proposed classification of Olacaceae (Nickeret, et al., *Taxon* 59: 538–558. 2010) which has been adopted here.

**Oleaceae:** Thorne & Reveal (2007) divided the family into two subfamilies, Jasminoideae Arn., *Botany*: 119. 9 Mar 1832 and Oleoideae Arn., *Botany*: 119. 9 Mar 1832. Takhtajan (2009) also recognized Fraxineae Bartl., *Ord. Nat. Pl.*: 218. Sep 1830 and Schreberae L.A.S. Johnson, *Contr. N.S.W. Natl. Herb.* 2: 397. 18 Nov 1957; both are here referred to Oleace.

**Onagraceae:** Onagradoideae was validly published by Beilschmied who stated (p. 104) that names in italics in his index were at the rank of subfamily (establishing a rank) and then gave a page number where he provided, in the case of Onagradoideae, a description in Latin associated with an effectively published but not valid name.

**Orchidaceae:** The placement of Pycnanthaceae, in synonymy under Orchidaceae, is provisional subject to a more detailed examination of the type species of *Pycnanthus*. Ravenna published the genus and family without any discussion or critical details of the taxa. Aside from an online image of the holotype (e.g., <http://plants.jstor.org/specimen/baa00000196>), no material is available for study. Stevens (2001, onward) has suggested the specimen may be teratological, and vegetatively the specimen is similar to *Malix* according to Mark Chase (pers. comm.), being, in my opinion, most similar to *M. excavata* Kuntze.

**Papaveraceae:** In addition to the above mentioned subfamilies, Takhtajan (2009) also recognized Platystemonoideae Luerss., *Handb. Syst. Bot.* 2: 602. Nov 1880.

**Peraceae:** If this family is included within Euphorbiaceae, as done by Takhtajan (2009), the name Peroideae Baill. ex Hassk., *Flora* 42: 649. 7 Nov 1859, is available.

**Phytolaccaceae:** Shipunov (2012), Stevens (2001–onward), and Takhtajan (2009) define this family broadly, including therein both Petiveriaceae, as Petiverioideae Arn., *Botany*: 125. 9 Mar 1832 (the later name Rivinoideae Nowicke in *Ann. Missouri Bot. Gard.* 55: 320. 30 Apr 1969 was adopted by Takhtajan), and Agdestidaceae, as Agdestidoideae Nowicke, *Ann. Missouri Bot. Gard.* 55: 355. 30 Apr 1969. Mabberley (2007) tentatively also included Microteioideae Eckardt ex Nowicke in *Ann. Missouri Bot. Gard.* 55: 346. 30 Apr 1969 (=Microteaceae) and Barbeuioideae Nowicke, *Ann. Missouri Bot. Gard.* 55: 356. 30 Apr 1969 (=Barbeuiaceae).

**Picrodendraceae:** If this family is included within Euphorbiaceae, as done by Takhtajan (2009), the name Hyaenanthoideae Baill. ex Hassk., *Flora* 42: 653. 7 Nov 1859, adopted by Thorne & Reveal (2007), has priority over Stachystemonoideae Baill. ex Hassk., *Flora* 42: 653. 7 Nov 1859 adopted by Takhtajan (2009). Both have priority over Oldfieldioideae Eg. Köhler & G.L. Webster in G.L. Webster, *J. Arnold Arbor.* 48: 308. Jul 1967.

**Pittosporaceae:** Takhtajan (2009) recognized two tribes: Pittosporaceae Rehb., *Handb. Nat. Pfl.-Syst.*: 270. 1–7 Oct 1837 and Billardiaceae Pax in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 2a: 109. 9 Mar 1891.

**Plantaginaceae:** Thorne & Reveal (2007) recognized five subfamilies: Veronicoideae Horan., *Char. Ess. Fam.*: 120. 17 Jun 1847, Globularioideae Luerss., *Handb. Syst. Bot.* 2: 1038. Sep 1882, Plantaginoideae Eaton, *Bot. Dict.*, ed. 4: 31. Apr–Mai 1836, Hippuridoideae Burnett, *Outlines Bot.*: 577, 1091, 1144. Feb 1835, and Callitrichoideae Arn., *Botany*: 110. 9 Mar 1832. Takhtajan (2009) assigned some members of Veronicoideae to Rhinanthoideae, retaining at the family level Globulariaceae, Plantaginaceae, Callitrichaceae, and Hippuridaceae; none of these families was subdivided into tribes. Recent work by Tank et al. (*Austral. Syst. Bot.* 19: 289–307. 2006) demonstrate that subfamilies should not be recognized in Plantaginaceae. Takhtajan retained both Mazaceae and Rehmanniaceae in his Rhinanthoideae.

**Plumbaginaceae:** The traditional use of Staticoideae Burnett, *Outlines Bot.*: 1028, 1095, 1101. Feb 1835, and that of Armeriaceae Dumort., *Anal. Fam. Pl.*: 27. 1829 or Staticeae Bartl., *Ord. Nat. Pl.*: 127. Sep 1830 must now be superseded by the mandated Limonioideae and Limoniaceae (Reveal 2012).

**Poaceae:** A few names, here maintained at the rank of subtribe, are considered by others to be at the rank of tribe or are here assigned to synonymy: Aveneae Dumort., *Observ. Gramin. Belg.*: 82. Jul–Sep 1824, Brylkiniae Tateoka, *Canad. J. Bot.* 38: 962. 1960, Hainardiaceae Greuter in W. Greuter & K.H. Rechinger, *Boissiera* 13: 178. 1967, Leptaspideae Tzvelev, *Komarov. Chten.* 37: 25. 19 Mar 1987,

Orcuttiae Reeder, *Madroño* 18: 20. 10 Feb 1965, Parianea C.E. Hubb. in J. Hutchinson, *Fam. Fl. Pl.* 2: 219. 20 Jul 1934, Phyllorachideae C.E. Hubb., *Hooker's Icon. Pl.* 34: t. 3386, p. 5. Mar 1939. Importantly, the name Hordeae (1820) has priority over Triticeae Dumort., *Observ. Gramin. Belg.*: 82. Jul–Sep 1824.

**Podostemaceae:** Takhtajan (2009) recognized two tribes in Podostemoideae: Podostemeae Dumort., *Anal. Fam. Pl.*: 62. 1829 and Mourereae Benth. & Hook.f., *Gen. Pl.* 3: 107. 7 Apr 1880.

**Polygalaceae:** Takhtajan (2009) grouped Moutabeae and Xanthophylleae under Moutabeoideae Takht., *Sist. Magnolioph. [Syst. Magnolioph.]*: 192. 24 Jun 1987 and recognized Polygaloidae Eaton, *Bot. Dict.*, ed. 4: 46. Apr–Mai 1836. The name Diclidanthereae now has priority over Moutabeae Chodat in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 329. Jul 1896 (Reveal 2012).

**Polygonaceae:** The oft recognized Atraphaxideae Dammer in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 1a: 8, 23. Mar 1892 is here included in Polygoneae.

**Pontederiaceae:** In addition to the two tribes noted here, Takhtajan (2009) also recognized Eichhornieae O. Schwartz, *Bot. Jahrb. Syst.* 61(Beibl. 139): 32, 50. 15 Jun 1927 which is included here in Pontederiaceae.

**Primulaceae:** APGIII (2009) and Stevens (2001–onward) define this family broadly including Maesaceae (as Maesoideae A. DC. in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 8: 76. medio Mar 1844), Theophrastaceae (as Theophrastoideae A. DC. in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 8: 145. medio Mar 1844) which was defined to include Samolaceae (as Samoleae Rehb., *Fl. Germ. Excurs.* 1(3): 398, 411. Jul–Dec 1831), and both Lysimachiaceae and Myrsinaceae (as Myrsinoideae Burnett, *Outlines Bot.*: 1025, 1095, 1102. Feb 1835). Takhtajan (2009) and Thorne & Reveal (2007) retains all but Lysimachiaceae as families which they placed in Primulaceae. Takhtajan also recognized Coridaceae, treated here as a tribe of Lysimachiaceae. Finally, Takhtajan also considered the genus *Cyclamen* to be the only member of “Cycaminoideae”, a name not yet validly published; the genus is here assigned to Myrsinaceae.

**Proteaceae:** Takhtajan (2009) recognized some additional tribes. In Proteoideae: Franklandieae Endl., *Gen. Pl.*: 339. Dec 1837; in Grevilleoideae he accepted seven tribes: Oriteae L.A.S. Johnson & B.G. Briggs, *Bot. J. Linn. Soc.* 70: 172. 3 Sep 1975, Knightieae L.A.S. Johnson & B.G. Briggs, *Bot. J. Linn. Soc.* 70: 172. 3 Sep 1975, and “Helicieae”. Weston (in Heywood et al. 2007) defined Embthrieae Meisn. in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 14: 211, 443. medio Oct 1856 to include the type of Grevilleae, an earlier name. Carnarvonioideae L.A.S. Johnson & B.G. Briggs, *Bot. J. Linn. Soc.* 70: 172. 3 Sep 1975 is here assigned to Grevilleoideae as Carnarvonieae.

**Ranunculaceae:** Takhtajan (2009) recognized several additional subfamilies and tribes here included in Ranunculoideae: Cimicifugoideae Arn., *Botany*: 95. 9 Mar 1832 with Cimicifugeae Torr. & A. Gray, *Fl. N. Amer.* 1(1): 34. Jul 1838 (a later name for Actaeaceae), and Eranthideae T. Duncan & Keener, *Phytologia* 70: 26. 1991; Trollioideae Raf., *Anal. Nat.*: 177. Apr–Jul 1815 with Trollieae Schrödinger, *Abh. K. K. Zool.-Bot. Ges. Wien* 4(5): 58. 1909; Aconitoideae Raf., *Anal. Nat.*: 176. Apr–Jul 1815 with Delphinieae Schrödinger, *Abh. K. K. Zool.-Bot. Ges. Wien* 4(5): 58. 1909 (a later name for Aconiteae); and Helleboroideae Beilschm., *Flora* 16(Beibl. 7): 77, 107. 14 Jun 1833. Nigellieae Schrödinger, *Abh. K. K. Zool.-Bot. Ges. Wien* 4(5): 59. 1909 is assigned here to Aconiteae. Within Ranunculoideae Takhtajan also accepted Trautvetterieae T. Duncan & Keener, *Phytologia* 70: 25. 1991 as distinct from Ranunculeae. Isopyroideae Schrödinger, *Abh. K. K. Zool.-Bot. Ges. Wien* 4: 59. 22 Sep 1909 was mentioned by Mabberley (2007) who assigned the taxon to Thalictrioideae but

maintained Isopyreae Schrödinger, *Abh. K. K. Zool.-Bot. Ges. Wien* 4(5): 59. 1909, a later name for Aquilegiaeae.

**Rapateaceae:** Takhtajan (2009) misspelled Schoenocephaleae as “Sphoenocephaleae”. Both he and Mabberley (2007) recognized the other two subfamilies adopted here but at the rank of tribe: Monotremateae Maguire in B. Maguire et al., *Mem. New York Bot. Gard.* 10: 21. 1 Jul 1958 and Rapateace M. Gómez, *Noc. Bot. Sist.*: 52. Apr–Dec 1893.

**Rhizophoraceae:** Thorne & Reveal (2009) recognized the two subfamilies recognized above; most other recent authors distinguish only tribes. When that is done Cassipoureae Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 119, Comm. 84. 8–14 Apr 1838 has priority of over Macarisieae Baill., *Hist. Pl.* 6: 295, 302. Jan–Mai 1876. Apparently the name Crossostylidae has not been validly published; *Crossostylis* J.R. Forst. & G. Forst. is here considered to be a member of Gynotrocheae.

**Rosaceae:** Takhtajan (2009) recognized more subfamilies than accepted above: Filipenduloideae Nakai, *Chosakuronbun Mokuroku* [Ord. Fam. Trib. Nov.]: 250. 20 Jul 1943; Kerrioidae Schneid., *Illustr. Handb. Laubholz.* 1: 500. 15 Jun 1905; Coleogynoideae E.I. Golubk., *Nauchnye Dokl. Vysshe Shkoly Biol. Nauki* 1991(3): 107. Mar 1991; Ruboideae Thomé, *Fl. Deutschl.* 3: 166. 1888; Potentilloideae Sweet, *Hort. Brit.*: 144. Aug–Sep 1826; Dichotomanthoideae Gladkova, *Bot. Zhurn.* (Moscow & Leningrad) 54: 436. 7–31 Mar 1969; Pyroideae Burnett, *Outlines Bot.*: 695, 1137. Feb 1835 (including the now nomenclaturally correct Maloideae C. Weber), and Amygdaloideae Arn., *Botany*: 107. 9 Mar 1832 (including Prunoideae Horan., *Char. Ess. Fam.*: 158. 17 Jun 1847). He also adopted “Lyonothamnoideae”, an unpublished name. In addition to the tribes accepted above, the following additional tribes were recognized by Takhtajan: Holodiseae Focke in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 3: 12. Dec 1888, Adenostomateae Rydb., *N. Amer. Fl.* 22: 240. 12 Jun 1908, “Rhodotypeae”, “Purshiaeae” (neither this name nor “Purshinaeae” has been validly published), Geaeae Juel, *Kongl. Svenska Vetensk. Akad. Handl.* 58(5): 77. 1918, a later name for Colurieae, Alchemillaeae Dumort., *Fl. Belg.*: 26. 1827, Sanguisorbeae DC., *Prodr.* 2: 588. medio Nov 1825, and “Potaninieae”. Tribes recognized by Takhtajan in his Pyroideae and Amgdaloideae, not accounted for above are: “Kageneckieae”, Crataegeae Koehne, *Gatt. Pomac.*: 8. 6 Apr 1890, Osmaronieae Rydb., *N. Amer. Fl.* 22(1): 482. 1918, *nom. illeg.* (here assigned to Exochordeae), and Prinsepiaeae Sterling, *Amer. J. Bot.* 50: 698. Aug 1963 (“Prinsepioideae”). Many authors use Pruneeae Benth. & Hook.f., *Gen. Pl.* 1: 601, 602. 19 Oct 1865, a later name for Amygdaleae DC. (1825). A change made in 2011 to the code of nomenclature governing plants resulted in Maloideae having priority over Spiraeoideae Arn., *Botany*: 107. 9 Mar 1832 and Amygdaloideae as well as Malinaeae having priority over Pyrinaeae Dumort., *Fl. Belg.*: 92. 1827 (Reveal 2012).

**Rubiaceae:** The arrangement of taxa presented here within the first two subfamilies of Rubiaceae is alphabetical. In addition to the above mentioned tribes, Takhtajan (2009) also recognized, Cruckshanksiaeae Benth. & Hook.f., *Gen. Pl.* 2: 9, 20. 7–9 Apr 1873 and Hedyotideae Cham. & Schtldl. ex DC., *Prodr.* 4: 342, 401. late Sep 1830 (= Rubioideae), Virectariaeae Verde., *Kew Bull.* 30: 366. 1975 and Henriquezieae Benth. & Hook.f., *Gen. Pl.* 2: 8, 12. 7–9 Apr 1873 (=Ixoroideae), and Catesbaeaeae Benth. & Hook.f., *Gen. Pl.* 2: 8, 17. 7–9 Apr 1873 (=Cinchonoideae). He maintained Theliganaceae as distinct from Rubiaceae. Mabberley recognized Cephalanthae Bartl., *Ord. Nat. Pl.*: 212. Sep 1830, Coccoepysaeae Bremek., *Recueil Trav. Bot. Néerl.* 31: 253. 1934, Lathracocarpeae Bremek., *Bull. Jard. Bot. État Bruxelles* 27: 165. 1975, and Triainolepidaeae Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, ser. C, 59: 3. Jan–Apr 1956 (=Rubioideae).

**Rutaceae:** In addition to the four subfamilies recognized here, authors also frequently accept Dictyolomoideae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 111. Mar 1896, Flindersioideae Luerss., *Handb. Syst. Bot.* 2: 681. Jun 1881, and Spatheleioideae Engl. in H.G.A.

Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 111. Mar 1896. Thorne & Reveal (2009) referred Dictyolomeoideae and Spathelioideae to Cneoroideae with the other two going to Rutoideae. Recent work suggests that Rutoideae should be restricted to just two genera with the remainder falling into Amylidoideae, an earlier name than Toddalioidae K. Koch, *Dendrologie* 1: 564. 1869; thus within Rutoideae is Ruteae Dumort., *Anal. Fam. Pl.*: 45. 1829. Recognition of tribes is in flux and which, if any, subtribes ought to be accepted is unsettled and no attempt is made here to present any suggestions on this matter. Galipeae is the correct name for the effectively published but not legitimate Cuspariae DC., *Mém. Mus. Hist. Nat.* 9: 141. 1822, a name frequently seen in the literature. Dictyolomeae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 169. Mar 1896 and Harrisoniae Planch., *London J. Bot.* 5: 569. 1846 are here included within Spathelieae, and Ptacoxyleae Harms in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 267, 270. Mai 1896 is assigned to Cneoroceae.

**Salicaceae:** In addition to the above tribes, Stevens (2001–onward) also recognized Saliceae Rehb., *Fl. Germ. Excurs.* 1(2): 165. Jan–Apr 1831 whereas Mabberley (2007) accepted Scyphostegiaceae Zmarzty in M.W. Chase et al., *Kew Bull.* 57: 170. 2002; neither recognized subfamilies.

**Sapindaceae:** In addition to the tribes mentioned above the following also are used occasionally: Lepisantheae Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8: 269. Jul–Dec 1878 (=Sapindeae); Nephelieae Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20: 253, 288. Jun 1890 (=Sapindeae); and, Thouinieae Blume, *Rumphia* 3: 186. Jun 1847 (=Paullinieae).

**Sapotaceae:** Takhtajan (2009) and numerous other recent authors assigned the type of the family to Mimosopeae Hartog, *J. Bot.* 17: 356. ante 17 Dec 1879 rather than adopt the nomenclaturally correct Sapoteae. Likewise, the earliest available name for the widely used Isonandreae T.D. Penn., *Gen. Sapotac.*: 147. 1991, is Palaquieae. Harthog published Isonandreae without a rank, and so did H.J. Lam (*Bull. Jard. Bot. Buitenzorg, sér. 3*, 8: 384. 1927) who, under Palaquieae, proposed “Eupalquieae”, a name that is not valid. Lam’s names are associated with a description in English and said to be “nov. div.” so that if taken literally, his remark would also mean his names were published at a misplaced rank. The first author who seems to have validated Isonandreae is Pennington, but it is possible this was done earlier. In a long paper otherwise devoid of validly published names, Baehni (*Boissiera* 11: 78. Jun 1965) managed to establish Isonandrinae.

**Scrophulariaceae:** Resolution of this family is as outlined above, or if one wishes to abandon subfamilies (as used here), then the linear sequence of tribes is the same. An alternative view is to define the family broadly as done by Takhtajan (2009), although even he did not reduce as many families as necessary to reflect the phylogeny of Lamiales as now understood. In addition to the tribes mentioned above, Takhtajan also recognized Verbasceae Dumort., *Anal. Fam. Pl.*: 24. 1829, Alonsoeae Baill., *Hist. Pl.* 9: 407, 425. Feb–Mar 1888, Freyliniae Barringer, *Novon* 3: 16. 19 Mar 1993, Manuleae Benth. & Hook.f., *Gen. Pl.* 2: 915, 919. 1–16 Mai 1876, Schlegelieae A.H. Gentry, *Fl. Neotrop. Monogr.* 25: 48. 19 Sep 1980, Paulowniae Pennel, *Proc. Acad. Nat. Sci. Philadelphia* 71: 226. Dec 1920, “Wightiae”, Collinsiae Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 304, Comm. 216. 25–31 Oct 1840, Melospermeae Rossow, *Parodiana* 3: 373. Aug 1985, Aragoeae D.Y. Hong & S. Nilsson, *Opera Bot.* 121: 278. 13 Oct 1993, and Rehmanniae Rouy, *Consp. Fl. France*: 199. 15 Aug 1927 (the last now assigned to Rehmanniaceae).

**Simaroubaceae:** Both Heywood et al. (2007) and Takhtajan (2009) retained Leitneriaceae although the evidence suggests that in spite of its unique (for the family) morphological features and distribution the taxon is situated well within Simaroubaceae.

**Solanaceae:** In addition to the names mentioned above, Takhtajan (2009) accepted Brownlowioideae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 599, 605. 22 Jul 1926, a later name for Cestroideae, and included Metternichiae Miers, *London J. Bot.* 5: 148. Mar–Mai 1846, Latueae Hunz. & Barboza, *Lorentzia* 8: 6. 31 Mai 1995, Francisceae G. Don, *Gen. Hist.* 4: 399, 476. 1837–8 Apr 1838 (given as “Francisceae”), and Schwenckiae Hunz., *Kurtziana* 10: 42. 25 Apr 1977 (here included in Schwenchioideae). He also considered Juanulloideae Hunz., *Kurtziana* 28: 59. 15 Aug 2000 (as “Juanulloideae”), Salpiglossioideae Benth. in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 10: 190. 8 Apr 1846, and Anthocercidoideae Tétényi, *Ann. Missouri Bot. Gard.* 74: 607. 22 Dec 1987 to be distinct from Solanoideae where they are treated here. In Solanoideae, Takhtajan also recognized Lyciae Lowe, *Man. Fl. Madeira* 2: 96. Jan–Apr 1872 and Jaboroseae Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 3: 178. Mar 1849.

**Staphyleaceae:** Mabberley mentioned both Staphyleoideae Arn., *Botany*: 105. 9 Mar 1832 and Tapiscioideae Pax in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 5: 259, 262. Mai 1893 when he recognized Staphyleaceae and Tapisciaceae.

**Stilbaceae:** Following Thorne (*Bot. Rev.* (Lancaster) 66: 441–647. 2000) and Rourke (*Bothalia* 30: 9–15. 2000), Takhtajan (2009) recognized “Nuxioideae” and “Retzioideae;” both unpublished names whose type genera are included here in Stilbeae. He also mentioned Bowkeriaceae but as defined by him the earlier name is Hallericeae. Both tribes are recognized here and assigned to Stilbaceae.

**Theaceae:** Mabberley (2007) mentioned Theoideae, a name in widespread use in the literature since 1964, having replaced the long-used Camellioideae Burnett, *Outlines Bot.*: 827, 1120. Feb 1835. Only recently was Theoideae validly published (Reveal 2012).

**Themidaceae:** If included within another family, as in Asparagaceae as suggested by APG III (2009), the name Brodiaeioideae Traub, *Pl. Life* 28: 131. 22 Feb 1972, is available.

**Thymelaeaceae:** Takhtajan (2009) recognized just Octolepidoideae Engl. & Gilg in H.G.A. Engler, *Syllabus*, ed. 7: 275. Oct 1912–Mar 1913 (now mandated to be Gonystyloideae, fide Reveal 2012) and Thymelacoideae, retaining Tepuianthaceae at the family level. He subdivided Octolepidoideae into Octolepideae, Solmsiae Domke, *Biblioth. Bot.* 111: 103. 31 Dec 1934, and the recently published Gonystyleae (Reveal 2012). Thymelacoideae are subdivided into Synandrodaphneae and Aquilariae, as above, and then Takhtajan (and Mabberley 2007) adopted Daphneae Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 330, Comm. 242. 18–24 Jul 1841 instead of the now nomenclaturally required Thymelaeae. In addition Takhtajan also recognized Phaleriae Benth. & Hookf., *Gen. Pl.* 3: 188. 7 Apr 1880 and Dicanolepideae Gilg in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 6a: 222. 10 Jul 1894; both are included here in Thymelaeae. Mabberley accepted both Aquilarioideae Meisn. in A.P. de Candolle & A.L.P.P. de Candolle, *Prodr.* 14: 495, 601. medio Oct 1856 and Aquilariae in Thymelacoideae as well as Synandrodaphnoideae Gilg, *Bot. Jahrb. Syst.* 53: 365. 19 Oct 1915 and Synandrodaphneae.

**Tiliaceae:** APGIII (2009, see Malvaceae) recognized Tilioideae Arn., *Botany*: 100. 9 Mar 1832. Within his circumscription of Tiliaceae, Takhtajan (2009) included several families accepted by Doweld (2001) and by Cheek in Heywood et al. (2007), all at the rank of tribe: Apeibeae Benth., *J. Proc. Linn. Soc., Bot.* 5(Suppl. 2): 55. 1861, “Enteleceae”, Corchoreae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 604, 864. 22 Jul 1926, Lueheae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 602, 822. 22 Jul 1926, Tiliaceae, Dubosciceae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 602, 817. 22 Jul 1926, “Desplatsiaceae”, Grewiceae, Coloneae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 602, 796. 22 Jul 1926, Triumfetteae Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 603, 861. 22 Jul 1926, and



**Craigieae.** Of these, only **Tiliaceae** and **Craigieae** are assigned here to **Tiliaceae** as the rest are placed in **Sparmanniaceae**.

**Turneraceae:** Stevens (2001–onward) and APGIII (2009) assigned this family to **Passifloraceae** as **Turneroideae** Eaton, *Bot. Dict.*, ed. 4: 44. Apr–Mai 1836.

**Urticaceae:** The above arrangement is a reasonable classification but may well be altered once the placement of *Poikilospermum* Zipp. ex Miq. is resolved.

**Verbenaceae:** In addition to the tribes recognized above, Mabberley (2007) and Takhtajan (2009) also accepted **Priveae** Briq. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* IV, 3a: 144, 155. 26 Feb 1895. Takhtajan also retained **Viticoideae** in this family (assigned here to **Lamiaceae**) and as a result recognized **Verbenoideae** Arn., *Botany*: 124. 9 Mar 1832.

**Violaceae:** Takhtajan (2009) and Thorne & Reveal (2007) recognized **Leoniodeae** Melch. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 21: 348, 376. 30 Jul 1925, here included in **Violioideae**.

**Viscaceae:** Takhtajan (2009) recognized three tribes: **Phoradendreae** Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 1: 190. Mar 1889, **Arceuthobieae** Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam. Nachtr.*: 125, 137. 2 Aug 1897, and **Visceae** Horan., *Char. Ess. Fam.*: 86. 17 Jun 1847. Another available tribal name in **Viscaceae** is **Ginallocae** Tiegh., *Just's Bot. Jahresber.* 24(2): 319. 1898.

**Winteraceae:** Mabberley (2007) suggested recognition of **Takhtajaniodeae** J.-F. Leroy, *Adansonia*, sér. 2, 17: 393. 1978 and **Winteroideae** Arn., *Botany*: 95. 9 Mar 1832. Here, however, Takhtajan's (2009) view is adopted.

**Zygophyllaceae:** Takhtajan (2009) recognized five subfamilies, two of which, **Tribuloideae** and **Zygophylloideae** are accepted here as he defined them. **Balanitoideae** is adopted here and not included in **Tribuloideae** as done by Stevens (2001–onward) and by Thorne & Reveal (2007) or recognized as a distinct family, **Balanitaceae**. If the two subfamilies are combined, **Balanitoideae** has priority. Takhtajan retained three of the subfamilies accepted here as tribes in **Zygophylloideae** as well as suggesting several other unique names that seemingly are not validly published: “**Seetzeniceae**”, **Sericodeae** Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 78, 89. Dec 1890 (here included in **Morkillioideae**), **Zygophylleae** Bartl., *Ord. Nat. Pl.*: 391. Sep 1830, “**Larceae**” (misspelled “**Larreae**”), and “**Morkillieae**”. The **Augeoideae** Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 4: 354. Jul 1896 are referred here to **Zygophylloideae**.

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Names in **bold** are accepted and followed by a family, subfamily, tribe or subtribe number or a combination of numbers and letters. Thus **Adenochilidinae** is family 69 (**Orchidoideae**), subfamily f (**Orchidoideae**), in the seventh tribe of that subfamily (**Diurideae**) where it is listed in the twelfth subtribe and assigned the letter “f”. Order and family names are numbered consecutively; subordinal names bear the number of the order followed by a letter. Thus **Monimiineae** in the second (“b”) suborder of the sixth order (**Laurales**). Superordinal names are assigned capital letters. Synonyms are in *italics* followed by a letter or number. Those at the rank of subclass are listed on pages 2 and 3 and are indicated by the Roman numeral XIII. Although synonym is given only for names at the ranks of family and above, some synonymy is given for lower ranks in the Notes and Comment section (p. 152). Such names are listed under the family name given after an equals sign. Only names

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#### VALIDATION OF NEW NAMES

The following new names are established primarily because the names have been used or implied without formal validation, or the names themselves, long in use, proved not to have been validly published due mainly to a lack of a validating a description or diagnosis. Several name that are not legitimate, but in current use, are replaced here with names that are legitimate.

- Abolbodoideae** Suess. & Beyerle ex Thorne & Reveal, subfam. nov., based on Abolbodaceae Nakai, *Chosakuronbun Mokuroku* [Ord. Fam. Trib. Nov.]: 221. 20 Jul 1943, associated with a description in Latin. – Type: *Abolboda* Humb. (1813). – Xyridaceae
- Aeonieae** Thiede ex Reveal, trib. nov. Plantis glanduosis; foliis rosulatis crassis; floribus polymeris; carpida follicularis indehiscentis aut demum basi receptaculo disruptionem; seminibus costatis. – Type: *Aeonium* Webb & Berthel. – Crassulaceae
- Alonsoinae** Reveal, subtrib. nov., based on Alonsoeae Baill., *Hist. Pl.* 9: 407, 425. Feb–Mar 1888, associated with a diagnosis in French. – Type: *Alonsoa* Ruiz & Pav. (1798). – Scrophulariaceae
- Anacolosideae** Sleumer ex Reveal, subfam. nov., based on Anacolosaceae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* III, 1: 233, 234. Mai 1889, associated with diagnoses in German. – Type: *Anacolosia* (Blume) Blume (1851). – Olacaceae. (The name was proposed by Takhtajan in 2009 but not validly published. It is here accepted as an subfamily name for purposes of validation.)
- Anemarrheneae** Reveal, trib. nov., based on Anemarrhenaceae Conran, M.W. Chase & Rudall, *Kew Bull.* 52: 995. Dec 1997, associated with a description in Latin. – Type: *Anemarrhena* Bunge (1831). – Agavaceae
- Anopteroideae** Reveal, subfam. nov., based on Anopteraceae Doweld, *Tent. Syst. Pl. Vasc.*: li. 23 Dec 2001, associated with a description in Latin. – Type: *Anopterus* Labill. (1805). – Escalloniaceae
- Azorelleae** Reveal, trib. nov., based on Azorelloideae G.M. Plunkett & Lowry, *J. S. African Bot.* 70: 379. 7 Oct 2004, associated with a description in Latin. – Type: *Azorella* Lam. (1783). – Apiaceae



- Behnieae** Reveal, trib. nov., based on Behniaceae Conran, M.W. Chase & Rudall, *Kew Bull.* 52: 996. Dec 1997, associated with a description in Latin. – Type: *Behnia* Ditr. (1855). – Agavaceae
- Bersamoideae** Reveal, subfam. nov., based on Bersameae Planch., *Trans. Linn. Soc. London* 20: 416. 1851, associated with a description in Latin. – Type: *Bersama* Fresen. (1837). – Melianthaceae
- Bhesoideae** Reveal, subfam. nov. Arbores glaberrimae; stipules magnis, deciduae; folia glabra, alternata, integerrima; raceme axillares; flores breviter pedicellati, parvi; calyx 5-fidus, segmentis recurvis; petala 5, torus discoideus, carnosus; stamina 5; ovarium sessile vel basi, globosum, liberum 2-loculare, loculis 2-ovulatis; ovula basi affixa, erect, collataerialia; styli duo cum stigmata parva, capitata; capsula 1-locularis, bivalvis, 1-2-locularis, coriacea; semina lineari-oblonga, erecta, arillo carnosus; testa membrancea; embryo axilis. – Type: *Bhesa* Ham. ex Arn. (1834). – Celastraceae
- Calochortoideae** Thorne & Reveal ex Reveal, subfam. nov., based on Calochortaceae Dumort., *Anal. Fam. Pl.* 53. 1829 (Calocorthineae), associated with a diagnosis in French. – Type: *Calochortus* Pursh (1813). – Liliaceae
- Canacomyricae** Reveal, trib. nov., based on Canacomyricaceae Baum.-Bod. ex Doweld, *Byull. Mosk. Obshch. Ispyt. Prir.*, Biol. 105(5): 59. 9 Oct 2000, associated with a description in Latin. – Type: *Canacomyrica* Guillaumin (1940). – Myricaceae
- Canarininae** Eddie ex Reveal, subtrib. nov., based on Canarineae Webb & Berthel., *Hist. Nat. Iles Canaries* 3(2,3): 1. Apr 1844, associated with a diagnosis in Latin. – Type: *Canarina* L., *nom. cons.* (1771). – Campanulaceae
- Capuroniantheae** Maberley ex Reveal, trib. nov., based on Capuronianthoideae T.D. Penn. & Styles, *Blumea* 22: 509. 24 Sep 1975, associated with a description in Latin. – Type: *Capuronanthus* Leroy (1958). – Meliaceae
- Carnarvonieae** Reveal, trib. nov., based on Carnarvonioideae L.A.S. Johnson & B.G. Briggs, *Bot. J. Linn. Soc.* 70: 172. 3 Sep 1975, associated with a description in Latin. – Type: *Carnarvonia* F. Muell. (1867). – Proteaceae
- Castillejeae** Reveal, trib. nov., based on Castillejinae G. Don, *Gen. Hist.* 4: 614. 1837–8 Apr 1838, associated with a diagnosis in English. – Type: *Castilleja* Mutis ex L.f. (1782). – Orobanchaceae
- Centroplacoideae** Reveal, subfam. nov., based on Centroplacaceae Radcl.-Sm., *Gen. Euphorb.*: 78. 2001, associated with a diagnosis in Latin. – Type: *Centroplacus* Pierre (1899). – Centroplacaceae
- Coleae** Bojer ex Reveal, trib. nov. Frutices vel arbusculae cum foliis pinnatis; cymae pedunculatae; calyx truncatus vel breviter 5-dentatus; ovarium 2-loculare; capsula indehiscens. – Type: *Colea* Bojer ex Meisn., *nom. cons.* (1840). – Bignoniaceae
- Croomieae** Reveal, trib. nov., based on Croomiaceae Nakai, *Iconogr. Pl. As. Orient.* 2: 159. Nov 1937, associated with a description in Latin. – Type: *Croomia* Torr. (1840). – Stemonaceae
- Delavayae** Reveal, trib. nov. Arbor, foliis alternis trifoliolatis; raceme axillares, saepius abbreviate. Flores hermaphroditi, 5-meri, regulares; sepala inaequalia, exterior minore, interior sensim majore; petala cum sepalis alternata, infra discum inserta, intus basi squamulata; discus evolutus, cupularis; stamina 8, hypogyna, antheris introrsis; ovarium triluculare cum loculis biovulatis; capsula lignose, inflata, compressa, biloba; semen in loculo solitarium, subglobosum. – Type: *Delavaya* Franch. (1886) – Sapindaceae
- Dicerocaryae** Reveal, trib. nov., based on an effectively published but not legitimate Pretreeae Benth. & Hook.f., *Gen. Pl.* 2: 1055. 1–16 Mar 1876, associated with a diagnosis in Latin. – Type: *Dicerocaryum* Bojer (1835 = *Pretrea* J. Gay ex Meisn., *nom. illeg.*) – Pedaliaceae
- Duckeodendroideae** Reveal, subfam. nov., based on Duckeodendraceae Kuhl., *Arg. Serv. Florest.* 3: 7. 1950, associated with a description in Latin. – Type: *Duckeodendron* Kuhl. (1925). – Solanaceae
- Epithemateae** Reveal, trib. nov., based on Epithematinae DC. ex Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 303, Comm. 212. 25–31 Oct 1840, associated with a diagnosis in Latin. – Type: *Epithema* Blume (1826). – Gesneriaceae

- Eriospermoideae** Reveal, subfam. nov., based on Eriospermeae Endl. ex Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 397, 400, Comm. 304. 17–20 Aug 1842, associated with diagnoses in Latin. – Type: *Eriospermum* Jacq. ex Willd. (1799). – Ruscaceae
- Hemimeridineae** Reveal, subtrib. nov., based on Hemimeridaceae Benth., *Edwards's Bot. Reg.* 21: ad t. 1770. 1 Feb 1835, associated with a diagnosis in Latin. – Type: *Hemimeris* L.f., *nom. cons.* (1782). – Scrophulariaceae
- Hemimeridoideae** Reveal, subfam. nov., based on Hemimeridaceae Doweld, *Tent. Syst. Pl. Vasc.*: xlix. 23 Dec 2001, associated with a diagnosis in Latin. – Type: *Hemimeris* L.f., *nom. cons.* (1782). – Scrophulariaceae
- Hugonioidae** Mabberley ex Reveal, subfam. nov., based on Hugoniace Meisn., *Pl. Vasc. Gen.*: Tab. Diagn. 35, Comm. 27. 21–27 Mai 1837, associated with a diagnosis in Latin. – Type: *Hugonia* L. (1753). – Linaceae
- Hypodaphnideae** Kostermans ex Reveal, trib. nov. A Lauraceae ceteris ovariis inferioribus differt. – Type: *Hypodaphnis* Stapf (1909). – Lauraceae
- Ioichrominae** Reveal, subtrib. nov., based on Ioichromeae Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 3: 178. Mar 1849, associated with a diagnosis in English. – Type: *Ioichroma* Benth., *nom. cons.* (1845). – Solanaceae
- Jaborosinae** Reveal, subtrib. nov., based on Jaboroseae Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 3: 178. Mar 1849, associated with a diagnosis in English. – Type: *Jaborosa* Juss. (1789). – Solanaceae
- Kaliphoreae** Reveal, trib. nov., based on Kaliphoraceae Takht., *Bot. Zhurn.* (Moscow & Leningrad) 81(2): 86. Mai–Jun 1996, associated with a diagnosis in Latin. – Type: *Kadsura* Juss. (1810). – Montiniaceae
- Kanieae** Peter G. Wilson ex Reveal, trib. nov., based on Kanioidae Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.*, ed. 2, 18a: 109. 3 Mai 1930, associated with a diagnosis in German. – Type: *Kania* Schltr. (1914). – Myrtaceae
- Kirengeshominae** Reveal, subtrib. nov., based on Kirengeshomaceae Nakai, *Chosakuronbun Mokuroku* [Ord. Fam. Trib. Nov.]: 245. 20 Jul 1943, associated with a description in Latin. – Type: *Kirengeshoma* Yatabe (1890). – Hydrangeaceae
- Laxmannioideae** Thorne & Reveal ex Reveal, subfam. nov., based on Laxmanniaceae Bubani, *Fl. Pyren.* 4: 111. 15–28 Feb 1902, associated with a poorly organized diagnosis in Latin. – Type: *Laxmannia* R. Br. (1810). – Laxmanniaceae
- Linconieae** Reveal, trib. nov., based on Linconioidae Nakai, *Chosakuronbun Mokuroku* [Ord. Fam. Trib. Nov.]: 242. 20 Jul 1943, associated with a description in Latin. – Type: *Linconia* L. (1771). – Bruniaceae
- Lindleyinae** Reveal, subtrib. nov., based on Lindleyaceae J. Agardh, *Theoria Syst. Pl.*: 166. Apr–Sep 1858, associated with diagnoses in Latin. – Type: *Lindleya* Kunth, *nom. cons.* (1824). – Rosaceae
- Lophopetaleae** Loes. ex Reveal, trib. nov. Arbores et frutices majuberrimi; folia opposita vel alterna, petiolate, exstipulata; cymosae axillares; flores saepe majusculi; calyx scutelliformis, lobis 5, rotundatis; petala 4–5, cristata, cum disco continua et din persistentis; stamina 4–5, disco inserta, filamentis subulatis; antherae oblongae; discus planus, 4–5-lobus, crassus; ovarium parvum, cum disco continuum et eo immersum, trigonum vel pyramidatum, 3–4-loculare, cum stylum brevem, contractum, stigante capitato; ovula in loculis 4; capsula coriacea, 3–4-angularis, dehiscens, loculis subdispermis; semina exalata, arillata. – Type: *Lophopetalum* Wight ex Arn. (1839). – Buxaceae. (The name was adopted by Takhtajan in 2009, and others before him, so the name is now validly published. It is here accepted as a new tribe for purposes of validation.)
- Macaranginae** G.L. Webster ex Reveal, subtrib. nov. A Cleidiinae antheris 3–4-thecis, stylis simplex, testis pulpis differt. – Type: *Macaranga* Thouars (1806). – Euphorbiaceae
- Mareyinae** Radcl.-Sm. ex Reveal, subtrib. nov. A Claoxylinae et Lobaniliinae exotestis nec pulpis differt. – Type: *Mareya* Baill. (1860). – Euphorbiaceae

- Muntingioideae** Reveal, subfam. nov., based on Muntingiaceae C.Bayer, M.W. Chase & M.F. Fay, *Taxon* 47: 38. 13 Feb 1998, associated with a description in Latin. – Type: *Muntingia* L. (1753). – Muntingiaceae
- Neuracanthaeae** Reveal, trib. nov. Herbae suffruticesve; folia integerrima; flores parvuli, ad axillas bractearum oppositarum solitarii, sessiles, dense spicati; bractae imbricate cum bracteoles 0; calyx 2-partitus, 3-dentato vel lobo postico, 2-dentato vel partito antico; corolla tubus superne parum ampliatus; stamina 4, didynama cum filamentis brevibus discretis et antheris 2-localaris cum loculis ovoideis distinctis parallelis altero paulo majore dorso ciliato; stylus apice dilatatus; 2–4-ovulati; capsula oblonga; semina 2–4, orbiculata compressa. – T.: *Neuracanthus* Nees (1832). – Acanthaceae
- Ondineinae** Reveal, subtrib. nov., based on Ondineae Tamura, *Acta Phytotax. Geobot.* 33: 344. 1982, associated with a description in Latin. – Type: *Ondinea* Hartog (1970). – Nymphaeaceae
- Oroxyleae** A.H. Gentry ex Reveal & L.G. Lohmann, trib. nov. A Tecomeae capsula elongate, lata, septo parallelo plano-compressa, septifraga dehiscens et placentae axillis differt. – Type: *Oroxylum* Vent. (1808). – Bignoniaceae
- Oxydendreae** Cox ex Reveal, trib. nov. Arbor; calyx 5-partitus, lobis acuminatis; corolla 5-dentata; stamina 10, filamentis crassis pilosiusculis, antheris oblongis, loculis apice discretis acuminatis sed muticis; stylus crassiusculus pentagonus; capsula pyramidata pentagona, 5-localaris, 5-valvis, valvis medio septiferis, suturis indistinctis. – Type: *Oxydendrum* DC. (1839) – Ericaceae
- Pachysandreae** Reveal, trib. nov., based on *Pachysandraceae* J. Agardh, *Theoria Syst. Pl.*: 358. Apr–Sep 1858, associated with diagnoses in Latin. – T.: *Pachysandra* Michx. (1803) – Buxaceae
- Pachystromateae** Reveal, trib. nov., based on Pachystromatinae Pax & K.Hoffm. in H.G.A. Engler, *Nat. Pflanzenn.* 68(Addit. VI): 3. 6 Jun 1919, associated with a diagnosis in German. – Type: *Pachystroma* Müll. Arg. (1865). – Euphorbiaceae
- Pentastemonoideae** Reveal, subfam. nov., based on Pentastemonaceae Duijfs, *Blumea* 36: 552. 9 Jun 1992, associated with a description in Latin. – Type: *Pentastemona* Steenis (1982). – Stemonaceae
- Phaceliinae** Reveal, subtrib. nov., based on Phacelieae Benth. ex A. Gray, *Proc. Amer. Acad. Arts* 10: 312. 1875, associated with a diagnosis in Latin. – Type: *Phacelia* Juss. (1789). – Boraginaceae
- Philadelphinae** Reveal, subtrib. nov., based on Philadelphae DC. ex Duby, *Bot. Gall.* 1: 184. 12–14 Apr 1828, associated with a diagnosis in Latin. – Type: *Philadelphus* L. (1753). – Hydrangeaceae
- Physalidinae** Reveal, subtrib. nov., based on Physalideae Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 3: 179. Mar 1849, associated with a diagnosis in English. – Type: *Physalis* L. (1753). – Solanaceae
- Prionieae** Reveal, trib. nov., based on Prioniaceae S.L. Munro & H.P. Linder, *Syst. Bot.* 23: 51. Mai 1998, associated with a diagnosis in Latin. – Type: *Prionium* E. Mey. (1832). – Juncaceae
- Prockioideae** Reveal, subfam. nov., based on Prockieae Endl., *Gen. Pl.*: 918. Nov 1839, associated with a diagnosis in Latin. – Type: *Prockia* P. Browne ex L. (1759). – Salicaceae
- Pycnometeae** Hutch. ex Reveal, trib. nov., based on Pycnometinae G.L. Webster, *Ann. Missouri Bot. Gard.* 81: 76. 21 Mar 1994, associated with a description in Latin. – Type: *Pycnometia* Benth. (1849). – Euphorbiaceae
- Quivisantheae** Reveal, trib. nov., based on Quivisanthoideae T.D. Penn. & Styles, *Blumea* 22: 508. 24 Sep 1975, associated with a description in Latin. – Type: *Quivisanthe* Baill. (1893). – Meliaceae
- Romanzoffiinae** Reveal, subtrib. nov., based on Romanzoffieae Dumort., *Anal. Fam. Pl.*: 26. 1829, associated with a diagnosis in French. – Type: *Romanzoffia* Cham. (1820). – Boraginaceae
- Salpichroinae** Reveal, subtrib. nov. Herbae suffrutices vel frutices; folia integra; pedicelli solitarii; flores albi vel flavi; calyx tubulosus vel brevis, 5-fidus vel 5-partitus; corolla longe tubulosa vel urceolata, lobi 5, valvati; stamina supra medium tubum affixa, inclusa vel breviter exserta cum filamentis filiformibus et antheris cum connective tenui, longitudinem dehiscentibus; discus

- carnosus, saepe crassus; ovarium 2-loculare cum stylis filiformis et stigmatibus dilatatis; bacca ovoidea vel oblonga; semina compressa. – Type: *Salpichroa* Miers (1845). – Solanaceae
- Sarumaceae** O.C.Schmidt ex Reveal, trib. nov., based on Sarumaceae Nakai, Fl. Sylv. Koreana 21: 17. 1936 (Sarumataceae), associated with diagnoses in Japanese and in English. – Type: *Saruma* Oliv. (1889). – Aristolochiaceae
- Schwenckioideae** Reveal, subfam. nov., based on Schwenckieae Hunz., *Kurtziana* 10: 42. 25 Apr 1977, associated with a description in Latin. – Type: *Schwenckia* L. (1764). – Solanaceae
- Spiraeanthemoideae** Reveal, subfam. nov., based on Spiraeanthemaceae Doweld, Tent. Syst. Pl. Vasc.: xxxi. 23 Dec 2001, associated with a description in Latin. – Type: *Spiraeanthemum* A. Gray (1854). – Cunoniaceae
- Stemodiaceae** Reveal, trib. nov., based on Stemodiinae Benth. & Hook.f., Gen. Pl. 2: 919. 1-16 Mai 1876 (*Stemodieae*), associated with a diagnosis in Latin. – T: *Stemodia* L., nom. cons. (1759). – Plantaginaceae
- Stenomeridoideae** Reveal, subfam. nov., based on Stenomeridaceae J. Agardh, *Theoria Syst. Pl.*: 66. Apr–Sep 1858. – Type: *Stenomeris* Planch. (1852). – Dioscoreaceae
- Streptopoideae** Mabberley ex Reveal, subfam. nov., based on Streptopeae Baker, J. Linn. Soc. London, Bot. 14: 522. 24 Apr 1875, associated with a diagnosis in Latin. – Type: *Streptopus* Michx. (1803). – Liliaceae
- Suregadeae** Reveal, trib. et nom. nov., validated by a full and direct reference to the diagnosis in Latin associated with a validly published but not legitimate J. Müller Argoviensis (in *Linnaea* 34: 202. Mar 1865, as *Geloniceae*) subtribe name. – Type: *Suregada* Roxb. ex Rottl. (1803). – Euphorbiaceae
- Takhtajaniaceae** Takht. ex Reveal, trib. nov., based on Takhtajanioidae J.-F. Leroy, *Adansonia*, sér. 2, 17: 393. 1978, associated with a diagnosis in Latin. – Type: *Takhtajania* Baranova & J.-F. Leroy (1978). – Winteraceae
- Tasmannieae** Takht. ex Reveal, trib. nov., based on [unranked] Tasmannieae Rehb., *Handb. Nat. Pfl.-Syst.*: 278. 1–7 Oct 1837, associated with a diagnosis in Latin. – *Tasmannia* R. Br. (1810). – Winteraceae
- Tepuianthoideae** Reveal, subfam. nov., based on Tepuianthaceae Maguire & Steyerl., *Mem. New York Bot. Gard.* 32: 8. 20 Mai 1981, associated with a description in Latin. – Type: *Tepuianthus* Maguire & Steyerl. (1981). – Thymelaeaceae
- Tetrameranthaceae** R.E. Fr. ex Reveal, trib. nov. Arbor; folia spiraliter disposita. Indumentis pilis stellatis; flores hermaphroditi, axillares, solitarii; sepala 4, petala 8, biserialia, imbricata; torus semiglobosus; stamina numerosa; carpella numerosa, stigmata trilobato adpresso sessili coronata cum ovulis 2. – Type: *Tetrameranthus* R.E. Fr. (1939). – Annonaceae. (The name was adopted by Takhtajan in 2009, and others before him, so the name is now validly published. It is here accepted as a new tribe for purposes of validation.)
- Tovomitaceae** Mabberley ex Reveal, trib. nov., based on Tovomitinae Planch. & Triana, *Ann. Sci. Nat. Bot.*, sér. 4, 13: 315. Jan–Jun 1860, associated with a diagnosis in Latin. – Type: *Tovomita* Aubl. (1775). – Clusiaceae
- Tribuloideae** D.M. Porter ex Reveal, trib. nov., based on Tribuleae Dumort., *Anal. Fam. Pl.*: 45. 1829, associated with a diagnosis in French. – Type: *Tribulus* L. (1753). – Zygophyllaceae
- Triosteaceae** Reveal, trib. nov., based on Triosteoidae Raf., *Ann. Gén. Sci. Phys. Bruxelles* 6: 88. Oct–Dec 1820 (*Triostinia*), associated with a diagnosis in French. – Type: *Triosteum* L. (1753). – Caprifoliaceae
- Triplostegioidae** Reveal, trib. nov., based on Triplostegiaceae A.E. Bobrov ex Airy Shaw, *Kew Bull.* 18: 269. 8 Dec 1965, associated with a description in Latin. – Type: *Triplostegia* Wall. ex DC. (1830). – Valerianaceae

- Whitfieldiae** Bremk. ex Reveal, trib. nov. Racemi terminales; calyx amplius membranaceus vel coloratus; corolla campanulata subaequaliter 5-loba; ovula in quoque loculo 2. – Type: *Whitfieldia* Hook.f. (1845). – Acanthaceae
- Witheringinae** Reveal, subtrib. nov., based on Witheringieae Miers, *Ann. Mag. Nat. Hist.*, ser. 2, 3: 179. Mar 1849 (Witheringeae), associated with a diagnosis in English. – Type: *Witheringia* L'Hér. (1789). – Solanaceae
- Xanthosieae** Reveal, trib. nov., based on Xanthosiinae Tausch, *Flora* 17: 354. 21 Jun 1834 (Xanthosieae), associated with a diagnosis in Latin. – Type: *Xanthostia* Rudge (1811). – Apiaceae

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COMPOSITAE OF CENTRAL AMERICA—I  
THE TUSSILAGINOIDE GENUS *ROBINSONECIO* (SENECIONEAE),  
MICROCHARACTERS, GENERIC DELIMITATION, AND EXCLUSION OF  
*SENECIOID SENECIO CUCHUMATENSIS*

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ABSTRACT

*Robinsonecio* has tussilaginoide microcharacters and is represented in Central America by a single species, the generic type *Robinsonecio gerberifolius*. A lectotype is designated for *Senecio gerberifolius*. *Senecio cuchumatensis* of Guatemala has been suggested to be a congener of *R. gerberifolius*, but its senecioid microcharacters are found here to exclude it from *Robinsonecio*.

KEY WORDS: Asteraceae, Central America, Compositae, Guatemala, Mexico, *Robinsonecio*, *Robinsonecio gerberifolius*, *Senecio cuchumatensis*, *Senecio gerberifolius*, Senecioneae.

*Robinsonecio* T.M. Barkley & Janovec (Compositae: Senecioneae: Tussilaginoideae) was segregated from the Lugentes subgroup (Barkley 1985) of *Senecio* L. (Senecioninae) based on its tussilaginoide microcharacters (often called "cacalioid" microcharacters, e.g., Robinson & Brettell 1973b, 1973b; Wetter 1983). The genus includes 2 species — *R. gerberifolius* (Sch. Bip. ex Hemsl.) T.M. Barkley & Janovec (alpine areas in southeastern Mexico and western Guatemala) and *R. porphyresthes* (T.M. Barkley & Janovec (Tamaulipas, Mexico). Barkley and Janovec (1996) noted that in *Robinsonecio* each style branch has a continuous stigmatic surface and that its anther collars are cylindrical, each character a tussilaginoide trait (Koyama 1967; Robinson & Brettell 1973b; Nordenstam 1978; Wetter 1983). While many tussilaginoide Senecioneae have polarized endothelial cell wall thickenings (Dormer 1962; Robinson & Brettell 1973b; Nordenstam 1978; Wetter 1983), Barkley and Janovec (1996) characterized the endothecium of *R. gerberifolius* as polarized and that of *R. porphyresthes* as radial.

Hemslay (1881) described *Robinsonecio gerberifolius* (sub *Senecio*) as having pubescent cypselae, whereas Barkley and Janovec (1996) gave the cypselae as glabrous. Williams (1975) allied *R. gerberifolius* (sub *Senecio*) with *S. cuchumatensis*, and indeed these two species are subscaepose herbs known only from similar montane habitats. Barkley and Janovec (1996) noted that *S. cuchumatensis* is similar in "gross aspect" to *Robinsonecio*, but they did not provide a nomenclatural transfer commenting that this must "await further information." Subsequently, Barkley (en schedula MO) annotated the type and paratype material of *S. cuchumatensis* as *Robinsonecio* using a non-published binomial based on *S. cuchumatensis*.

The present study supports *Robinsonecio* as belonging to the tussilaginoide generic alliance (subtribe Tussilaginoideae), evidenced by its cylindrical anther collars (fig. 1A–B) that are no broader than the filaments and by its style branches (fig. 1E) each with a continuous stigmatic surface. However, I find *R. gerberifolius* to have adaxial endothelial tissue composed of elongate cells each with a radial cell wall thickening pattern (fig. 1C), and with only a thin line of elongate cells of the non-polliniferous connate zone between adjacent anther thecae as having polar thickenings (fig. 1D). It should be noted that while, for example, Jeffrey and Chen (1984) characterized the Tussilaginoideae

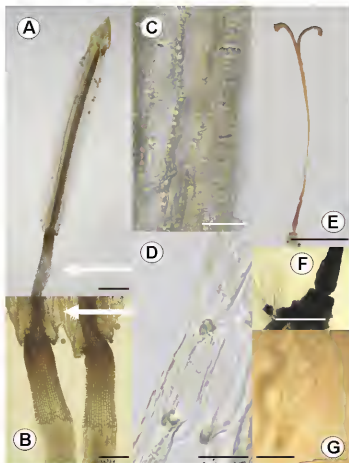


Figure 1. Microcharacters of *Robinsonecio gerberifolius*. A. Individual anther theca showing abaxial face of anther collar-filament junction (arrow) and apically acute anther appendage. B. Abaxial close-up of the cylindrical tussilagmoid anther collars with arrow pointing to (basal portion of) connate zone between two adjacent anther thecae. C. Medial adaxial endothechal tissue with radially thickened (transversely ribbed) cell walls. D. Medial adaxial border of individual anther showing connate zone cells with thickenings at their poles. E. Style showing slightly dilated stipitate base sitting atop the basal nectary rather than immersed within nectary. F. Close-up of style base, nectary, and apical portion of a pilose ovary. G. Glabrous cypsel. (A–D, G from Pruski & Ortiz 4163, MO; E–F from García *et al.* 1901, MO). [Scale bars: A 0.3 mm, B 0.1 mm, C, D 20  $\mu$ m, E 2 mm, F 0.2 mm, G 1 mm]



as having polarized endothelial tissue composed of nearly isodiametric cells (as indeed is a tendency, especially in Asian genera of the subtribe), both Dormer (1962) and Wetter (1983) noted some intraspecific variation in this character. Although *Robinsonecio*, by radiate capitula and yellow disk corollas with lobes shorter than the throats, does not match the "calceoid condition" (Pippen 1968), several Central American genera subsequently accepted as tussilaginoide (Barkley et al. 1996) have radiate capitula, yellow corollas, and short disk corolla lobes. The disk corolla lobes of *R. gerberifolius* are triangular-lanceolate to lanceolate and its anther appendages are acute apically (fig. 1A). The styles of *R. gerberifolius* are only slightly dilated at the base. Thus basal stylar node is not immersed in the nectary, but rather sits on a stipe atop the nectary (fig. 1E–F) as in the free stylopodium type 1 in Wetter (1983: figs. 14 and 17). The ovaries and cypselae of *R. gerberifolius* have carpopodia that, as noted by Barkley and Janovec (1996), are moderately developed (fig. 1G). As described by García-Peréz (2001), the ovaries and cypselae of *R. gerberifolius* vary from being glabrous to pilose (fig. 1F–G). Elsewhere, for example, Koyama (1967) noted similar intraspecific cypselae indumentum variation in Asian taxa.

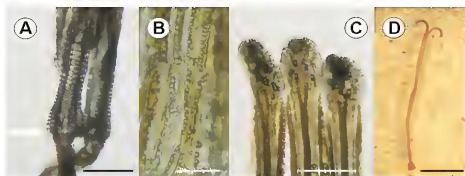


Figure 2. Microcharacters of *Senecio cuchumatensis*. A. Balusterform (senecioid) anther collars showing on the anther on the left the abaxial junction (arrow) with the narrower filaments. B. Medial adaxial endothelial tissue with radially thickened cell walls. C. Broadly rounded anther appendage apices. D. Style showing abruptly dilated style base (not showing nectary) (all from *Steyermark 50117*, MO, a paratype). [Scale bars A, C 0.2 mm, B 30  $\mu$ m, D 2 mm.]

These microcharacters of *Robinsonecio* contrast with those of *S. cuchumatensis*, which has the senecioid microcharacters of (1) moderately balusterform (distal cells somewhat quadrangular and basal cells isodiametric, with slight cell wall thickening basally) anther collars broader than the filaments (fig. 2A) and (2) each style branch (fig. 2D) with a 2-banded stigmatic surface with clear "morphological distinction between the cells" (Wetter 1983) of the stigmatic surfaces and those of the medial groove. *Senecio cuchumatensis* differs further from *Robinsonecio* by triangular disk corolla lobes, apically broadly rounded anther appendages (fig. 2C), and by its abruptly dilated large-celled style bases (fig. 2D) that arise within the low annular (slightly darker colored, slightly wider) nectaries. This stylopodium type more or less matches the "partially immersed" configuration seen in Wetter (1983: fig. 16), but the style base in *S. cuchumatensis* is much more dilated than in any of the six tussilaginoide photographs in Wetter (1983: figs. 14–19). Although Wetter (1983) notes stylopodial features as notoriously variable, here it appears to be useful taxonomically. *Senecio cuchumatensis* may thus be safely excluded from *Robinsonecio* and retained in *Senecio*. Although *S. cuchumatensis* has a radial endothelial pattern (fig. 2B) similar to that typical for *Robinsonecio* (fig. 1C), nearly all senecioid genera and most American tussilaginoide genera share this radial endothelial condition.

The purpose of the present account is to illustrate the microcharacters used to circumscribe *Robinsonecio*, to provide an expanded description of *R. gerberifolius* that may be inserted into Williams (1976), and to show that on the basis of microcharacters *S. cuchumatensis* should not continue to be aligned with *Robinsonecio*. While both *R. gerberifolius* and *S. cuchumatensis* are subscapose herbs occurring in the Sierra de los Cuchumatanes, with *S. cuchumatensis* endemic to this range, the similarities between these two species are basically incidental.



Figure 3. *Robinsonecio gerberifolius*, showing the subscapose habit, the prominent basal rosette, and radical leaves adaxially nitidous with impressed midribs (Pruski & Ortiz 4163).

ROBINSONECIO T.M. Barkley & Janovec, Sida 17: 79. 1996. TYPE: *Senecio gerberifolius* Sch. Bip. ex Hemsl. [= *Robinsonecio gerberifolius* (Sch. Bip. ex Hemsl.) T.M. Barkley & Janovec].

**Small subscapose perennial rosulate herbs**, caudex thick, root fibrous; scapes 1(–2) per plant, basally copiously floccose to lanate, sometimes glabrate distally, rosette prominent (Fig. 3), cauline leaves remote and reduced; herbage lanate to glabrate, eglandular. **Rosette leaves** spirally alternate; blade secondary venation indistinct, base gradually attenuate onto narrowly winged petiolar base that is dilated near caudex, margins entire to remotely denticulate, sometimes revolute, surfaces often discolorous. **Cauline leaves** sessile, margins entire. **Capitulescence** erect or ascending, laxly cymose, 1–6-capitulate. **Capitula** radiate; involucre campanulate, irregularly and loosely calyculate; phyllaries 13–20, imbricate, arachnoid or villous at least proximally, often glabrate distally, margins of inner phyllaries sometimes broadly scarious; receptacle solid. **Ray florets** pistillate; corolla yellow or golden-yellow, limb well-exserted. **Disk florets** bisexual, slightly exserted from involucre; corolla narrowly funnelliform, yellow, glabrous, tube and limb subequal, lobes triangular-lanceolate to lanceolate, ascending to sometimes slightly spreading, with or without a medial resin duct; anthers mostly included, collar cylindrical, equal in diameter to filaments, thecae base obtuse, not caudate, endothelial tissue typically radial, apical appendage triangular, acute apically; style base cylindrical to slightly dilated and sitting atop the basal nectary rather than immersed within nectary, branches weakly exserted, slightly recurved, apex obtuse to truncate, papillose in a subapical-abaxial semicircle below apex, stigmatic surface continuous. **Cypselae** cylindrical, 10-nerved, base gradually narrowed, carpodium prominent; pappus bristles of rays and disks similar, white, barbellate, about as long as the disk corollas.  $x = 30$ .

*Robinsonecio* is defined primarily by the tussilagino microcharacters of cylindrical anther collars and continuous stigmatic surfaces, and secondarily by subscapose habit, radiate capitula, yellow disk corollas with triangular-lanceolate lobes, and acute anther appendage apices. The genus consists of two species and is centered in Mexico, but the following species is disjunct from Pico de Orizaba to the Sierra de los Cuchumatanes in Guatemala.

ROBINSONECIO GERBERIFOLIUS (Sch. Bip. ex Hemsl.) T.M. Barkley & Janovec, Sida 17: 79. 1996. *Senecio gerberifolius* Sch. Bip. ex Hemsl., Biol. Cent.-Amer., Bot. 2: 240. 1881, as "gerberaeifolius." LECTOTYPE (designated here): MEXICO. Veracruz-Puebla border. Pico de Orizaba, 3500 m (as "11500 ft"), Apr 1838, *Linden 487* (lectotype: K, left-hand side, photo in MO; isolecotype: GH). (Figs. 1, 3–4).

**Herbs** 15–33 cm tall, scapes usually 1–3-leaved. **Rosette leaves** long-petiolariform, spreading to patent; blade 2–15 × 0.7–2.5(–3.5) cm, narrowly oblanceolate or oblong to spatulate or obovate, subcoriaceous, midrib sometimes impressed adaxially, apex acute to less commonly obtuse, slightly to obviously discolorous, adaxial surface gray-green to green, sometimes nitidous, arachnoid-floccose to glabrate, abaxial surface grayish-white, tomentose to lanate; petiolar base 1–8 cm long. **Cauline leaves** 1–3; blade 2–7 cm long, lanceolate or infrequently oblanceolate, semiamplexicaule. **Capitulescence** scape 14–31.2 cm long, striate or few-angled, densely floccose or lanate to sometimes arachnoid or glabrate in patches; peduncles (when pluricephalous) 1–8(–10) cm long. **Capitula** 10–18 mm tall; involucre 10–15 mm diam., loosely arachnoid-floccose in bud; phyllaries ca. 13, 8–13 × 2–3.5 mm, elliptic-lanceolate to narrowly ovate, typically greenish-yellow throughout, pluristriate, arachnoid proximally and glabrate distally, apex acute, sometimes purplish; calycular bracteoles 1–5(–7), 7–12 × 0.7–1.1 mm, about 3/4 as long as the phyllaries, linear-lanceolate, green; receptacle convex, foveolate. **Ray florets** usually 13(11–15); corolla tube 5–6 mm long, limb 11–15 × 3–4 mm, elliptic-lanceolate, 4–9-nerved, 3-denticulate, apical teeth 0.1–0.3 mm long. **Disk florets** 35–65; corolla 8–10 mm long, lobes 1–1.6 mm long, typically with a medial resin duct; anthers 2.5–3

mm long, endothelial tissue radial or sometimes polarized, non-polliferous connate zone between anthers usual with cells thickened at poles; style branches 1.2–1.5 mm long. *Cypselae* 3–4 mm long, brown, glabrous to pilose, trichomes to 0.5+ mm long; pappus 6.5–8.5 mm long.  $2n = 60$ .

**Representative specimens examined.** MEXICO. Mexico. Telapón, 4000 m, Dec 1928, *Lyonnet* 395 (MO, NY); Ixtaccihuatl, subalpine region, Oct 1905, *Purpus* 1516 (F, MO, NY). **Puebla.** Slopes of Ixtaccihuatl above Huejotzingo, 4260 m, 21 Oct 1945, *Hernández & Sharp* X-154 (MO). **Veracruz.** Cerca de la Roca del Cofre Perote, 4000 m, 28 Aug 1971, *Dorantes* 324 (MO, XAL); Cima del Volcán Cofre de Perote, 4180 m, 2 Oct 1984, *García et al.* 1901 (MO). **Veracruz-Puebla border.** Pico de Orizaba, 3048–4552 m (as 10000–15300 ft.), *Liebmenn* 8853 (*specimens number* 140) (C [photograph sub Macbride negative #22623 in MO], K); Pico de Orizaba, volcanic ash, ca. 4 km N of summit, 3925 m, 15 Feb 2007, *Pruski & Ortiz* 4163 (MO). **GUATEMALA.** Huehuetenango. Cumbre de la Sierra de los Cuchumatanes, 28 Dec 1940, *Standley* 81489 (F); On high limestone bluff of Caxín, between Tojquía and Caxín bluff, summit of Sierra de los Cuchumatanes, 3700 m, 6 Aug 1942, *Steyermark* 50181 (F, MO).

**Distribution and ecology.** *Robinsonecio gerberifolius* is known from alpine and subalpine pine forests, rocky areas, and meadows where it flowers sporadically throughout the year, but with a peak seemingly between July–December. The species is typified by material from Pico de Orizaba, the highest mountain in Mexico, and also occurs on Nevado de Toluca (García-Peréz 2001), a very few other high summits in the Trans Mexican Volcanic Belt, and the Sierra de los Cuchumatanes range in Guatemala. Although it does not seem to be known in Chiapas (Breedlove 1986), it should be looked for on Volcán Tacaná along the Chiapas–Guatemala border.

**Typology.** Barkley and Janovec (1996) listed *Linden* 487 in GH as an isotype. Although *Linden* 487 is mechanically the first of three syntypes and the typology of Barkley and Janovec (1996) indicates basically that they saw authentic material of one of the three syntypes, it nevertheless seems appropriate to formally designate *Linden* 487 in K as the lectotype of this name.

Although *Robinsonecio gerberifolius* has cypselae that vary from glabrous to pilose (fig. 1F–G), capitula with 1–5(–7) calycular bracts, and the Guatemalan plants are very narrow-leaved, I too circumscribe *R. gerberifolius* broadly and apply this name to material from Guatemala as per the Jesse Greenman determination (albeit within "*Senecio* sect. *Tomentosi* Rydb." sensu Greenman 1901, 1902) of *Steyermark* 50178 (F, MO) and as treated in the specimens examined section by Barkley and Janovec (1996).

Excluded species: *Senecio cuchumatensis* L.O. Williams & Ant. Molina, *Phytologia* 31: 438. 1975. TYPE: GUATEMALA. Huehuetenango. On high limestone bluff of Caxín, between Tojquía and Caxín bluff, summit of Sierra de los Cuchumatanes, 3700 m, 6 Aug 1942, *Steyermark* 50170 [as "50107"] (holotype: F, photograph in MO; isotype: MO). (Fig. 2).

*Senecio cuchumatensis* was noted by Williams (1975) as resembling *R. gerberifolius*, suggested by Barkley and Janovec (1996) as a possible species of *Robinsonecio*, and type material of this name was subsequently annotated by Barkley (en schedula MO) as a species of *Robinsonecio*. Although the species is known to me from only two badly bug-damaged collections, its technical features are intact. This species is shown here as having senecioid microcharacters and is retained in *Senecio*.





Figure 4. *Robinsonecio gerberifolius*, showing a few pine needles embedded in the basal rosette. (Pruski & Ortiz 4163, MO).

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**A TAXONOMIC CONSPECTUS OF PHRYMACEAE:  
A NARROWED CIRCUMSCRIPTION FOR *MIMULUS*,  
NEW AND RESURRECTED GENERA, AND NEW NAMES AND COMBINATIONS**

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**ABSTRACT**

A revised taxonomic classification of Phrymaceae down to species level is presented, based on molecular-phylogenetic and morpho-taxonomic studies, setting a framework for ongoing work. In the concept adopted, the family includes 188 species divided into 13 genera. All species as currently understood are listed and assigned to genera and sections which in several cases have new circumscriptions requiring many new combinations. Four main clades are recognized. **Clade A.** An Asian-African-Australasian-centered clade of 7 genera: *Mimulus* L. sensu stricto (7 species) of North America, Asia to Africa, and Australasia is sister to an Australian-centered group that comprises *Elacholoma* (2 species), *Glossostigma* (5 species), *Microcarpaea* (2 species), *Peplidium* (4 species), *Uvedalia* (2 species) and a new monotypic genus *Thyridia*, described here. The remaining three clades are largely American, with a few east Asian species. **Clade B.** Monotypic *Phryma* forms its own clade. **Clade C.** *Hemichaena* (5 species), *Mimetanthe* (1 species), and *Diplacus* (46 species). **Clade D.** *Leucocarpus* (1 species) and *Erythranthe* (111 species). A new infrageneric classification is constructed for the two largest genera — *Diplacus* with six sections, and *Erythranthe* with 12. The sessile to subsessile flowers and parietal placentation of *Diplacus* distinguish it from *Erythranthe*, which has long-pedicellate flowers and axile placentation. Descriptions are provided for all inframilial, generic, and infrageneric taxa and full synonymies enable a comparison with previous classifications.

**KEY WORDS:** *Mimulus*, *Uvedalia*, *Microcarpaea*, *Elacholoma*, *Peplidium*, *Glossostigma*, *Thyridia*, *Diplacus*, *Erythranthe*, *Mimetanthe*, *Hemichaena*, *Leucocarpus*, *Phryma*, Phrymaceae, Mazaceae, sections, typification

## TAXONOMIC SUMMARY

*Mimulus* L. sensu stricto includes only two primarily eastern North American species, *M. ringens* L. (the type) and *M. alatus* Sol. ex Ait., and five species from Asia and the Southern Hemisphere: *M. gracilis* R. Br. (here confined to Australia), *M. strictus* Benth. (resurrected for Old World plants previously identified mostly as *M. gracilis*), *M. madagascariensis* Benth., *M. aquatilis* A.R. Bean, and *M. orbicularis* Wall. ex Benth. The sister clade is Australian-centered, including the long-recognized genera *Elacholoma* F. Muell. & Tate (2 named species, one formerly *M. prostratus* Benth.), *Glossostigma* Wight & Arn. (5 species), *Microcarpaea* R. Br. (2 species), *Peplidium* Delile (4 species), *Uvedalia* R. Br. (2 species, removed from traditional *Mimulus*), and monotypic *Thyridia* W.R. Barker & Beardsley, gen. nov. (type *T. repens*, formerly *Mimulus repens* R. Br.). Monotypic *Phryma* L. forms its own clade. The remaining two clades are largely American, with a few east Asian species: one includes *Hemichaena* Benth. (5 species), *Mimetanthe* Greene (1 species), and *Diplacus* Nutt. (46 species); the other includes *Leucocarpus* D. Don (1 species), and *Erythranthe* Spach (111 named species). *Diplacus* includes species segregated by A.L. Grant as subg. *Schizoplacus* and by Nuttall, Bentham, Greene, and others as the genera *Diplacus* and *Eunanus*. *Mimetanthe* was recognized as a monotypic section by Bentham and Asa Gray and then at generic rank by Greene in 1886. *Erythranthe* comprises species mostly segregated by A.L. Grant as subg. *Synplacus*, including the group of species closely related to the type, *E. cardinalis* (sect. *Erythranthe*). In a sister relationship to *Erythranthe* is the monotypic genus *Leucocarpus*; sister to *Diplacus* is *Mimetanthe*, and sister to that pair is *Hemichaena*. Sister to the combined *Hemichaena*-*Mimetanthe*-*Diplacus* and *Leucocarpus*-*Erythranthe* clade is *Phryma*. *Diplacus* is divided into 6 sections (types in parenthesis): (1) sect. *Erimimimulus* G.L. Nesom & N.S. Fraga, sect. nov. (*D. parryi*), (2) sect. *Eunanus* (Benth.) G.L. Nesom & N.S. Fraga, comb. nov. (*D. nanus*), (3) sect. *Pseudoenoe* (A.L. Grant) G.L. Nesom & N.S. Fraga, comb. nov. (*D. pictus*), (4) sect. *Oenoe* (A. Gray) G.L. Nesom & N.S. Fraga, comb. nov. (*D. tricolor*), (5) sect. *Cleisanthus* (J.T. Howell) G.L. Nesom & N.S. Fraga, comb. nov. (*D. douglasii*), and (6) sect. *Diplacus* (*D. aurantiacus*). *Erythranthe* is divided into 12 sections (types in parenthesis): *Erythranthe* is divided into 12 sections (types in parenthesis): (1) sect. *Achlyopitheca* G.L. Nesom & N.S. Fraga, sect. nov. (*E. inconspicua*), (2) sect. *Paradantha* (A.L. Grant) G.L. Nesom & N.S. Fraga, comb. nov. (*E. rubella*), (3) sect. *Monantha* G.L. Nesom & N.S. Fraga, sect. nov. (*E. primuloides*), (4) sect. *Monimanthe* (Pennell) G.L. Nesom & N.S. Fraga, comb. nov. (*E. breweri*), (5) sect. *Erythranthe* (*E. cardinalis*), (6) sect. *Alsinimimulus* G.L. Nesom & N.S. Fraga, sect. nov. (*E. alsinoides*), (7) sect. *Sinopitheca* G.L. Nesom & N.S. Fraga, sect. nov. (*E. sessilifolia*), (8) sect. *Simigemma* G.L. Nesom & N.S. Fraga, sect. nov. (*E. gemmipara*), (9) sect. *Mimulasia* G.L. Nesom & N.S. Fraga, sect. nov. (*E. tenella*), (10) sect. *Mimulosma* G.L. Nesom & N.S. Fraga, sect. nov. (*E. moschata*), (11) sect. *Exigua* G.L. Nesom & N.S. Fraga, sect. nov. (*E. exigua*), and (12) sect. *Simiola* (Greene) G.L. Nesom & N.S. Fraga, comb. nov. (*E. guttata*). Lectotypes are designated for *Mimulus* subg. *Synplacus*, *Erythranthe* sect. *Paradantha*, *Erythranthe* sect. *Simiola*, and four unranked but validly published species groups named by Bentham: § *Erecti*, § *Prostrati*, § *Speciosi*, and § *Teneri*.

Recent molecular-phylogenetic studies have greatly altered concepts of families of the traditional Scrophulariaceae (e.g., Olmstead and Reeves 1995; Oxelman et al. 2005; Tank et al. 2006; Beardsley & Olmstead 2002; Beardsley et al. 2004; Beardsley & Barker 2005). Surprisingly, *Mimulus* L. sensu lato is indicated to be closely related to the monotypic genus *Phryma* L., which usually has been placed in Verbenaceae or Lamiaceae (e.g., Whipple 1972). Also closely related to *Phryma* and *Mimulus* are the American genera *Hemichaena* Benth., *Leucocarpus* D. Don, and a group of small Australian-centered genera: *Elacholoma* F. Muell. & Tate, *Glossostigma* Wight & Arn., *Microcarpaea* R. Br. and *Peplidium* Delile. The correct family name for this group of 188



species is Phrymaceae (see below). Recent phylogenetic studies have centered on Phrymaceae and its close relatives (Beardsley & Olmstead 2002; Beardsley et al. 2004; Beardsley & Barker 2005).

The study by Beardsley et al. (2004) included about 105 species that are maintained in the current account and provides a useful guide toward understanding the taxonomy and systematics of American *Mimulus* sensu lato. It strongly supports the hypothesis that a broadly conceived *Mimulus* is not monophyletic. Beardsley and Barker (2005) concentrated on providing a phylogenetic hypothesis for the Australian species, confirming Barker's (1982, 1986) view that the highly modified semiaquatic Australian-centered genera had close relationships with *Mimulus* in the Mimuliniaceae (Wettstein 1891) or Mimuleae (Bentham & Hooker 1876) of the traditional Scrophulariaceae. To that time these genera had been placed with other genera of small aquatics or semi-aquatics in the Gratiolaceae (Bentham & Hooker 1876) or in subtrib. Limosellinae of the Gratiolaceae (Wettstein 1891); they were not listed close to *Mimulus*, *Phryma* and *Mazus* Lour., reflecting their obscure relationships. More recently, Fischer (2004) resurrected Trib. Microcarpaeae Miq. (as "Microcarpaeae") for such small, often aquatic or semi-aquatic plant groups of "uncertain placement in Digitaloideae" (as "Digitaloideae").

The genera *Mazus* Lour. (ca. 25-30 species) and *Lancea* J.D. Hook. & T. Thomson (2 species) were weakly supported as forming a clade sister to *Mimulus* sensu lato in Beardsley and Olmstead (2002) and were tentatively included in the Phrymaceae at the rank of subfamily ("Mazoideae" ined.). Later studies have placed these two genera apart from Phrymaceae sensu stricto (Oxelman et al. 2005; Albach et al. 2009; Schäferhoff et al. 2010) and essentially agreed that the family is most appropriately constituted as treated here. Mazaceae, as now formally described (Reveal 2011), is available to include both *Mazus* and *Lancea*. Plants of the latter two genera, however, have bilamellate, sensitive stigmas like the Phrymaceae and Reveal's brief description of Mazaceae does not distinguish it morphologically from Phrymaceae. We are unable to find apomorphies to distinguish Phrymaceae, but it seems likely that further morphological study will corroborate the distinction between Mazaceae and Phrymaceae. The broader phylogenetic patterns underlying the taxonomy of the present treatment are derived primarily from molecular analyses, as also apparently with Reveal's implicit assumption.

### Phylogenetic relationships within Phrymaceae

Molecular-phylogenetic studies in the Phrymaceae over the last decade, notably by Beardsley and Olmstead (2002), Beardsley et al. (2004), and Beardsley and Barker (2005), are summarized in a phylogeny of the family shown in Figure 1. This diagram shows that species of Phrymaceae are divided into four major clades, denoted as Clade A, the "Australasian-Old World lineage," Clade B, the monotypic *Phryma* (its phylogenetic position not well-resolved), and Clades C and D, constituting an "American-Asian lineage." The phylogenetic diagram is based on a subset of species in most taxa. To complete a comprehensive taxonomic account of the family, additional taxa have been interpolated based on morphological features. We note under the genera and infrageneric taxa where there are doubts about traditional infrageneric placement of species.

The "Australasian-Old World lineage" includes 23 named species (with about 17 yet to be named; Table 1) from Australia, New Zealand, southeastern Asia, eastern North America, India, Madagascar, and South Africa. In the earliest divergence within this lineage, *Mimulus* sensu stricto, based on DNA sequences from the type *M. ringens*, *M. alatus* and *M. gracilis* is sister to a lineage that includes Australian-centered genera. The six genera are these: *Elacholoma*, *Glossostigma*, *Microcarpaea*, and *Peplidium*, which have long been recognized, and two groups that have been placed previously in *Mimulus* in its traditionally broad circumscription — one of these groups is recognized here by the resurrected generic name *Uvedalia* R. Br., the other in the new genus *Thyridia*.

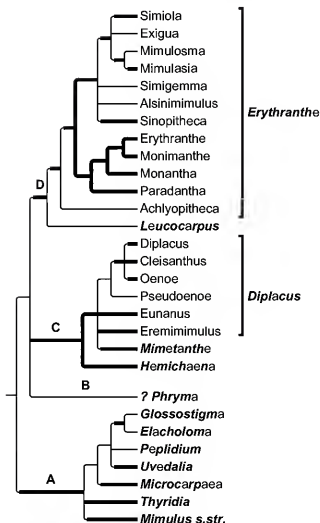


Figure 1. Summary/hypothesis of phylogenetic relationships of Phrymaceae essentially as defined by Oxelman et al. (2005), primarily from data from Beardsley et al. (2004) and Beardsley and Barker (2005), showing the generic and infrageneric classification adopted here. Nodes with less than 50% bootstrap support are collapsed. *Thyridia* has a 59% bootstrap value but that node was collapsed in the strict consensus tree, so it is collapsed here. Bolded branches indicate greater than 80% bootstrap support. The position of *Phryma* is based on a maximum likelihood tree inferred using combined data (Beardsley & Olmstead 2002), alternatively, the ML tree resulting from the analysis of nrDNA ITS and ETS sequence data places *Phryma* at the base of the tree and sister to the remaining Phrymaceae. A is the Australasian-Old World lineage, B-C-D the American-Asian lineage. Genera are in bold italic and sections in normal font. Sectional names in *Diplacus* and *Erythranthe* include those newly proposed here.

The "American-Asian lineage" includes 165 species (Table 1) from North, Central, and South America, and southeast Asia. This lineage includes two genera from Mexico and Central America — (1) *Hemichaena*, which is sister to the monotypic North American *Mimetanthe* and a resurrected North American genus *Diplacus*, and (2) *Leucocarpus*, which is sister to a group of North American and Asian species here placed in a resurrected genus *Erythranthe*. These clades, designated Clade C and Clade D, respectively in Figure 1, are interpreted as indicating two distinct radiations of *Mimulus* sensu lato in western North America..

*Phryma* is divided between eastern North America and eastern Asia. Molecular data provide two alternative relationships of the genus to the two major clades. A maximum likelihood tree inferred using combined data (Beardsley & Olmstead 2002) places it as sister to the "American-Asian lineage." Alternatively, the ML tree resulting from the analysis of nrDNA ITS and ETS sequence data positions *Phryma* as sister to the remaining genera of Phrymaceae. In view of its morphological disparity, the latter position seems most probable for *Phryma*, which could ultimately return to its status as a monotypic family.

### Taxonomic options

The phylogenetic placement of *Mimulus* sensu stricto, separate from other species included in *Mimulus* in North America, Central America, South America, and Southeast Asia, leads to consideration of how the group might be best treated taxonomically and nomenclaturally to provide an informative and stable taxonomic framework. Four general options are outlined below, accompanied by our evaluation of each. Relative merits of taxonomic approaches to the same problem also have been discussed by Beardsley and Olmstead (2002) and Beardsley and Barker (2005).

#### 1. A phenetic, polyphyletic or paraphyletic approach, enabling retention of current generic circumscriptions with minimal name changes for species.

Maintain the taxonomic and nomenclatural status quo, recognizing *Mimulus* either as polyphyletic following the Grant's (1924) broad circumscription of the genus, adopted also by later authors (represented by *Mimulus* sensu stricto, *Diplacus* and *Erythranthe* in Fig. 1), or as biphyletic (if *Leucocarpus* and *Hemichaena* are incorporated within *Mimulus*).

**We prefer to recognize monophyletic taxa, especially because the clades are strongly supported by molecular data and most are morphologically distinctive. Where morphological differences appear to be minimal (see notes below on *Mimulus* s. str. vs. *Erythranthe*), we suspect that further study will provide better discrimination.**

#### 2. A phyletic approach with minimal species name changes, minimally informative at generic level.

Treat Phrymaceae as comprising the single genus *Mimulus* L. *Uvedalia*, *Thyridia*, *Elacholoma* partly, *Hemichaena*, and *Leucocarpus* already have names in *Mimulus*. This would require fewer than 13 new combinations for species in Australian-centered genera and the one in *Phryma*.

**Maximally enlarging *Mimulus* results in the loss of much useful information in the taxonomic hierarchy that recognizes the Australian-centered genera as well as *Phryma*, *Leucocarpus*, *Hemichaena*, *Diplacus*, *Mimetanthe*, and *Erythranthe*, each of which has apparent apomorphic features that justify treatment at generic rank.**

#### 3. A phyletic approach, highly informative at generic level, with minimal species name changes through conservation of *Mimulus* L. with a new type.

Retaining *Mimulus* for a large number of species under this scenario would require conserving the name *Mimulus* L. with a different type species chosen from one of the two American

generic-level groups *Diplacus* or *Erythranthe*. This would enable *Phryma* and the Australian-centered genera to be maintained at generic level. A new name (*Cynorrhynchium*) would apply to the species separated here as *Mimulus* sensu stricto.

The least nomenclaturally disruptive course under this scenario is to maintain the 164 species (excluding *Phryma*) of North America, Central America, South America, and Asia in a single genus with the name *Mimulus*, though it would require combining five genera in the American-Asian lineage recognized in the current account (Fig. 1) into *Mimulus*, requiring the exclusion of *Leucocarpus*, *Mimetanthe* and *Hemichaena*. This option was one suggested by Beardsley and Barker (2005) and was the rationale for formally bringing *Leucocarpus* and *Hemichaena* into *Mimulus* (Nesom 2011a). Grant (1924) already had included one of the *Hemichaena* species within *Mimulus* (as sect. *Tropanthus*).

A second alternative under this approach would be to maintain *Leucocarpus*, *Mimetanthe*, and *Hemichaena*, as well as *Diplacus* and *Erythranthe*, as distinct genera. The name *Mimulus* L. would be maintained for the larger group, *Erythranthe*, by conserving it with a new type chosen from among those 111 species, where the few species of *Mimulus* in the traditional sense that are significant in horticulture and genetic studies belong, as discussed below. About 35 further name changes would be required for recognition of *Diplacus* as a distinct genus, but this would need to happen whether or not the name *Mimulus* is conserved.

This option requires use of a different name for the group of eight species currently treated as *Mimulus* L., including *M. ringens* L. and *M. alatus* Ait., widespread species mostly in the eastern USA, as well as for others of Asia and the Southern Hemisphere. The option that prompts the fewest name changes at species rank submerges *Hemichaena* and *Leucocarpus*, both of which are justifiably treated as distinct genera, as are *Diplacus* and *Erythranthe*. Alternatively, by recognizing all American genera in the current account but conserving *Mimulus* with a new type chosen from within *Erythranthe*, about 43 name changes still would be required for recognition of *Diplacus* and to accommodate the species formerly of *Mimulus* sensu stricto.

#### 4. A phyletic approach highly informative at generic level, retaining *Mimulus* with its Linnaean type, requiring many name changes for species of *Diplacus* and *Erythranthe*.

Treat *Mimulus* sensu stricto as seven species, maintaining the currently recognized Australian-centered genera (adding the new monotypic genus *Thyridia* and resurrected *Uvedalia*) and the Asian-American *Phryma*, *Leucocarpus*, *Mimetanthe* and *Hemichaena*. Under this option the remainder of the two American clades would be segregated at generic rank. The resurrected segregates (*Erythranthe* and *Diplacus*) are two credible genera, immediately discernable by a conspicuous feature of relative pedicel length (long-pedicellate vs. short-pedicellate flowers), and they have different placentation and modes of capsule dehiscence. Species of *Hemichaena*, *Mimetanthe*, *Leucocarpus*, and some species of the two resurrected genera already have species names in those genera, reflecting traditions of separation from *Mimulus*. About 136 new combinations are needed for American-Asian species; a much smaller set of combinations is required in Australasia.

This is the option followed here. It maximally incorporates and reflects phylogenetic information now available from recent molecular studies, particularly the recognition of two distinct major radiations in western North America and the relationship of the eastern USA species to the Asian-African-Australasian lineage. This option is essentially similar to the second alternative of option 3, but it requires more name changes (adding those necessary for *Erythranthe*). While requiring the greatest number of name changes, option 4 is based on simple priority and normal typification. It avoids a need to invoke conservation under the ICN,

thus retaining the original Linnaean genus and species (*Mimulus* L., *Mimulus ringens* L.) in their original conception, without the necessity of making new combinations in *Cynorrhynchium* J. Mitchell for *M. ringens* and others of *Mimulus* L. sensu stricto described by Bentham, Aiton, and Robert Brown. It also avoids the peculiar situation of recognizing one of the major groups of western American species (*Diplacus*) by a segregate name while maintaining the other group (*Erythranthe*) as *Mimulus*. Not required is a wait of six years for a formal decision on conservation by the IBC.

In relation to our decision to maintain *Mimulus* as a small genus, we note that a recent proposal (O'Kane et al. 1999) to conserve the name *Lesquerella* (88 species) for the genus formed by the merger of *Lesquerella* with the older *Physaria* (22 species) was rejected (Brummitt 2000). *Eupatorium* has been reduced from a huge genus (ca. 800 species) to one of about 40 species (King & Robinson 1987), with a number of the segregates considerably larger than the remaining *Eupatorium* sensu stricto. On the other hand, names were recently conserved for *Centaurea* (Greuter et al. 2001; Brummitt 2004) and *Acacia* (Orchard & Maslin 2005; Brummitt 2004; Luckow et al. 2005; McNeill et al. 2011) — but these involved potential name changes in 5 and 10 times more species than is the case in the *Mimulus* example. Decisions on *Acacia* at two international congresses were made narrowly, and the controversy is not over, perhaps not even settled (Smith & Figuieredo 2011; Brummitt 2011; Turland 2011). Where endorsement is sought for changing long-established names primarily on the grounds of reduced number of nomenclatural changes, future IBC nomenclatural sessions may not be so much in agreement with the nomenclatural committee's recommendations.

Other rationale for conserving *Mimulus* with a new type is not so strong. While popular horticultural species known as *Mimulus* appear exclusively to belong to American-centered generic elements that do not include the generic type, they are relatively few in number. In *Erythranthe*, they include the subshrubby *E. cardinalis*, herbaceous *E. guttata*, and the South American *E. lutea* and *E. cuprea*, and in *Diplacus* *D. bigelovii* and the woody *D. aurantiacus* and *D. puniceus* of sect. *Diplacus*. Genetic studies have focused intensely on species of *Erythranthe*, but relatively few species are involved — *E. cardinalis* and *E. lewisii* of sect. *Erythranthe* and *E. guttata* and *E. nasuta* plus a few others of sect. *Simiola*.

### Taxonomic comparisons and synonymy

Selected taxonomic works dealing at a family level or with the genus *Mimulus* are summarized in Table 1, but detailed comparison of classifications is set out in the synonymies and misapplications presented in the Appendix to the taxonomic treatment. Synonymies are confined to key publications for each group. Thompson (2005) gives a complete synonymy for *Diplacus*. Details of synonymy for much of *Erythranthe* are presented in studies published simultaneously with the present one (Nesom) and submitted (Fraga). Revisions are in progress in the Australasian-Old World lineage (Barker).

### Summary of current classification compared with those of the past

Circumscription of some genera recognized in this study has been consistent for more than 150 years, namely *Microcarpaea*, *Peplidum*, *Glossostigma*, *Phryma*, *Mimetanthe*, and *Leucocarpus* (see Table 1). These long perceived distinctions, confirmed by molecular data, are maintained in our classification.

*Mimulus* previously has been defined with an alternatively narrow or broad circumscription, but it has consistently included *Mimulus* sensu stricto (in the sense adopted here) and the Australasian *Thyridia*, *Uvedalia*, and *Elacholoma prostrata*. *Erythranthe* of Asia and the Americas has also been previously consistently placed in *Mimulus*, apart from Greene's (1885) inclusion of some species in *Eunamus*. This group (our *Erythranthe*) is Grant's (1924) subgenus *Symplocus* of *Mimulus*.

Table 1. Genera of Phrymaceae adopted, with numbers of named and unnamed species and new species combinations, together with the historic application of generic and infrageneric names to them in selected significant global and regional taxonomic works. Bracketed are their infratamil placements in Scrophulariaceae ("S."), including Brown's "sections." Works in grey are regional or not covering all representatives known at time.

New genera	New combi-nations	Total species (named, un-named)	Brown 1910	Bentham 1835	Bentham 1846	Bentham & Hooker 1876	A. Gray 1876a (Dec)	Greene 1895	A. Gray 1896a	Wettstein 1891	A.L. Grant 1924	Barker 1892, etc.	Fischer 2004
Phrymaceae (world)			Scrophulariaceae (Australia)	Scrophulariaceae (India, also world <i>Mimulus</i> )	Phrymaceae (world)	Verbenaceae (world)	Phrymaceae (N. Amer.)	<i>Mimulus</i> and allies (N. Amer.)	Scrophulariaceae (N. Amer.)	Scrophulariaceae; Brquet 1895	<i>Mimulus</i> (Scroph.)	Barker & Harden 1999	Scrophulariaceae ("alternative family") (world; no spp. listed)
<i>Mimulus</i> s. str.	-	7 (7-)	<i>Mimulus</i> (S.) - Sect. II. <i>Siamia</i> 4 antherifera)	<i>Mimulus</i> (S.) - Gratiolaeae)	<i>Mimulus</i> § <i>Erecti</i> , § <i>Prostrati</i> (S.) - Antirrhinoideae - Gratiolaeae - Eragratiolaeae)	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Gratiolaeae - Mimuleae)	<i>Mimulus</i> § <i>Eumimulus</i> (N. Amer.)	<i>Mimulus</i> § <i>Eumimulus</i> (N. Amer.)	<i>Mimulus</i> § <i>Eumimulus</i> (N. Amer.)	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (subg. <i>Syrplacus</i> ) - sect. <i>Eumimulus</i> - sect. <i>Paradanthus</i>	<i>Mimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimuleae)
<i>Thyridia</i> gen. nov.	1	1 (1-)	<i>Mimulus</i> (S.) - Sect. II. <i>Siamia</i> 4 antherifera)	<i>Mimulus</i> (S.) - Gratiolaeae)	<i>Prostrati</i> (S.) - Antirrhinoideae - Gratiolaeae - Eragratiolaeae)	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Gratiolaeae - Mimuleae by citation "Benth. in DC."	-	-	-	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (subg. <i>Syrplacus</i> ) - sect. <i>Paradanthus</i>	<i>Mimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	? <i>Mimulus</i> (S.) - "Phrymaceae" - Mimuleae)
<i>Microcarpaea</i>	-	2 (2-)	<i>Microcarpaea</i> (S.) - Sect. I. <i>Siamia</i> duo antherifera. Capsula bilocularis)	<i>Microcarpaea</i> (S.) - Gratiolaeae)	<i>Microcarpaea</i> (S.) - Rhamnanthideae - Buddleaeae)	<i>Microcarpaea</i> (S.) - Gratiolaeae - Limoselleae)	-	-	-	<i>Microcarpaea</i> (S.) - Antirrhinoideae - Gratiolaeae - Limosellinae)	-	<i>Pepidium</i> / <i>Microcarpaea</i> → <i>Microcarpaea</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Microcarpaea</i> (S.) - Microcarpaeae)
<i>Uvedalia</i>	1	4 (2, 2)	<i>Uvedalia</i> (S.) - Sect. II. <i>Siamia</i> 4 antherifera)	<i>Uvedalia</i> (S.) - Gratiolaeae)	<i>Mimulus</i> § <i>Erecti</i> (S.) - Antirrhinoideae - Gratiolaeae - Eragratiolaeae)	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Gratiolaeae - Mimuleae by citation "Benth. in DC."	-	-	-	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (subg. <i>Syrplacus</i> ) - sect. <i>Eumimulus</i>	<i>Mimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	? <i>Mimulus</i> (S.) - "Phrymaceae" - Mimuleae)
<i>Pepidium</i>	-	14 (4, 10)	-	<i>Pepidium</i> (S.) - Gratiolaeae)	<i>Pepidium</i> (S.) - Antirrhinoideae - Gratiolaeae - Limoselleae)	<i>Pepidium</i> (S.) - Gratiolaeae - Limoselleae)	-	-	-	<i>Pepidium</i> (S.) - Antirrhinoideae - Gratiolaeae - Limosellinae)	-	<i>Pepidium</i> / <i>Microcarpaea</i> → <i>Pepidium</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Pepidium</i> (S.) - Microcarpaeae)
<i>Elacholoma</i> ( <i>E. hornii</i> )	1	3 (2, 1)	-	-	-	-	-	-	-	-	-	<i>Elacholoma</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Elacholoma</i> (S.) - "Phrymaceae" - Microcarpaeae)
<i>Elacholoma</i> ( <i>E. prostrata</i> )	-	see above	-	-	<i>Mimulus</i> § <i>Erecti</i> , § <i>Prostrati</i> (S.) - Antirrhinoideae - Gratiolaeae - Eragratiolaeae)	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Gratiolaeae - Mimuleae by citation "Benth. in DC."	-	-	-	<i>Mimulus</i> sect. <i>Eumimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (subg. <i>Syrplacus</i> ) - sect. <i>Paradanthus</i>	<i>Mimulus</i> (S.) - Antirrhinoideae - Gratiolaeae - Mimulinae)	<i>Mimulus</i> (S.) - "Phrymaceae" - Mimuleae)

Table 1, continued.

Our series	New com- pounds	Total species (incl. un- named)	Brown 1970 Scrophulariaceae (Australia)	Bentham 1926 Scrophulariaceae world through world through	Bertram 1946 Scrophulariaceae Scrophulariaceae Physicaceae (world)	A. Gray 1867 1868 1869 1870 1871 1872 1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 252
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Our classification diverges most radically in the two largest genera, *Diplacus* and *Erythranthe*. *Diplacus* has been subject to varied interpretations, ranging from an infrageneric group within *Mimulus* to 2–4 groups sometimes recognized within a broader *Mimulus*, at other times in major part recognized as three genera — a narrower *Mimulus*, *Diplacus*, and *Eunamus* Benth. *Diplacus* corresponds largely to Grant's (1924) subgenus *Schizoplacus* of *Mimulus*. *Erythranthe* has generally been narrowly circumscribed as the group of mostly red-flowered species including *Mimulus cardinalis* and its close relatives.

*Hemichaena* historically has been poorly known and sometimes included in *Mimulus*. The genus *Berendiella* was merged with it by Thieret (1972b). Apart from *Berendiella*, only two other genera described in the past 150 years are not recognized here: *Eunamus* Benth. (1846) in its original concept only, which is our section of that name in *Diplacus*, and *Tricholoma* Benth., here merged into *Glossostigma*.

At a family level *Phryma* and *Elacholoma* have been doubtfully placed since their discovery. The relationship of *Phryma* with *Mimulus* in the Scrophulariaceae was established by recent molecular study (Beardsley & Olmstead 2002), that of *Elacholoma* with the work of Barker (1982).

In terms of tribal placements of genera in Scrophulariaceae, *Mimulus* and its sometimes recognized generic relatives *Uvedalia*, *Mimetanthe*, *Diplacus*, and *Eunamus* have been consistently placed in the tribe Mimuleae (or Gratiroleae subtribe Mimulinae). The genera *Microcarpaea*, *Peplidnum*, and *Glossostigma* were traditionally separated tribally in the Scrophulariaceae in the Limoselleae (or Gratiroleae subtrib. Limosellinae), a repository for often small semi-aquatics of obscure relationships, until the work of Barker (1982). *Leucocarpus* and *Hemichaena* were generally placed in the tribe Cheloneae until the work of Grant (1924).

### Rank and typification of genera and sections

Several species groups at sectional rank in *Mimulus* have been recognized in previous studies (e.g., Grant 1924; Pennell 1947; Vickery 1966a, 1966b, 1969, 1974, 1997; Beardsley 2003; Beardsley et al. 2004; Thompson 2005; Whittall et al. 2006) and are clearly typified. Some sections have been named but never typified and are provided here with lectotypes. Some of the species groups are provided here for the first time with formal names at sectional rank.

The § symbol was used for infrageneric groups in all the key historic works dealt with here, with varying clarity as to whether they had a consistent and specified rank. Infrageneric ranks were not or rarely clearly specified in the works of the 19<sup>th</sup> Century. These names of uncertain rank are validly published under Rule 35.3 of the ICN and are available as basionyms for their use with specified rank.

Within *Mimulus*, Bentham (1846) named four species groups using plural adjectives preceded by the § symbol. In the genera *Linaria* (loc.cit., pp. 266–288) and *Herpestis* (loc.cit., pp. 392–401), Bentham explicitly designated sections using substantives and, using the same convention (the § symbol and plural adjective), delineated subsidiary species groups that could justifiably be regarded either as subsections or series. In the absence of clarity as to which rank Bentham intended, the names are lectotypified but maintained without rank.

Bentham and Hooker (1876) clearly specify that their groups were sections, but Gray (1876a, 1876b, 1884, 1886a, 1886b) and Greene (1885) rarely applied a rank term. When they used a term it was generally section and only in discussion. Gray uses the term section in notes in his second publication, and it was used by Lemmon in publishing Gray's sect. *Mimulastrum* (Gray 1884), but Gray (1886b) also used subgenera in discussion (describing *Mimulus* as "Polymorphous, but better



retained entire under five subgenera"). Greene indicated that his infrageneric groups were sections in discussion under only one of his genera, *Eumamus*. Grant (1924) clearly and consistently applied the ranks (subgenus and section) to each of her infrageneric taxa, a convention followed for example by Pennell (1935, 1947, 1951) and made mandatory from 1953 (ICN Art. 35).

### Species delimitation

The authors of this paper have adopted convergent approaches to species delimitation in studies of various parts of the family, basing their decisions on herbarium and field studies and specimen sampling of variation within and between populations and observations of sympatric and parapatric interactions among taxa.

The species of *Diplacus* have received recent detailed taxonomic study (McMinn 1951; Beeks 1962; Ezell 1970; Waayers 1996; Tulig & Clark 2000; Thompson 2005; Tulig & Nesom 2012). Within *Diplacus* sensu lato, the mostly shrubby or semi-shrubby entities (sect. *Diplacus* or sometimes segregated as the separate genus *Diplacus* sensu stricto) clearly arose from ancestors of annual duration. These entities have been treated taxonomically in widely varying ways; the concepts here are those of Tulig (2000; formally summarized by Tulig and Nesom (2012). Also within *Diplacus*, *Eumamus* has previously been segregated as a genus but is treated here at sectional rank.

Species concepts in *Erythranthe* have remained more controversial or poorly understood, despite a treatment by Thompson (1993). The present overview is accompanied by detailed studies of the *Mimulus moschatus* alliance (sect. *Mimulosma*, sensu Nesom 2012b), the *Mimulus guttatus* group (sect. *Simiola*, Nesom 2012a), and the *Mimulus inconspicuus* group (sect. *Achlyopitheca*, Nesom 2012c). A detailed study of the *Mimulus palmeri* lineage (*Erythranthe* sect. *Paradantha* sensu stricto) is being conducted by Fraga (2011 and in prep.).

For precise reference to species and species groups in taxonomic treatments for the Flora of North America North of Mexico (FNANM; Nesom with Fraga and Tulig, in prep.) as well as in further detailed studies in various species groups, the species of *Diplacus* and *Erythranthe* in the classification presented here are divided into groups that primarily reflect the phylogenetic hypothesis of Beardsley et al. (2004, Figs. 1/5 and 2/4). Species not included in the molecular analysis are interpolated in the classification on the basis of morphological features.

Pennell (1951) treated 107 species of *Mimulus* from the Pacific States, but other treatments, particularly including those by Thompson (1993, 2005), have placed a number of earlier-accepted taxa in synonymy, thus considerably reducing the number of species. Many recent studies of evolutionary processes in *Mimulus*, however, emphasize that reproductive isolating mechanisms may sometimes evolve relatively quickly among populations (e.g., Wu et al. 2007), and our own studies have confirmed that recognition of conservative numbers of species in some groups do not accurately represent the variation patterns of *Mimulus* sensu lato. In the *Mimulus palmeri* lineage (here as *Erythranthe* sect. *Paradantha*) (Fraga 2011 and in prep.), studies in field and lab have shown that at least five species remain to be described. In the *Mimulus guttatus* group (here as *Erythranthe* sect. *Simiola*), the *M. floribundus* group (here as *Erythranthe* sect. *Mimulosma*), and the *M. inconspicuus* group (here as *Erythranthe* sect. *Achlyopitheca*), narrower species concepts of earlier studies by E.L. Greene, A.L. Grant, and F.W. Pennell have been corroborated in some cases (Nesom 2012b, 2012a, 2012c).

A revision of the the Australasian-centered genera and *Mimulus* sensu stricto (Barker in prep.) will adopt the generic concepts in this paper and will result in formal description of species denoted by informal phrase-names in Beardsley and Barker (2005), further unnamed species, confirmation of

generic placement, and erection of infrageneric taxa, particularly in *Peplidium*. To date genera and species have been described in a series of regional and state floras and associated publications (Barker 1981, 1982, 1983, 1986, 1990, 1992a, 1992b; Barker & Harden 1992, 1999). Bean (1997, 2003) has also described single species in *Microcarpaea* and *Mimulus* *sensu stricto*. The species numbers for the Australasian-centered genera are those given in the account of Beardsley and Barker (2005).

Further work under way is investigating the basis of significant homoplasy in striking synapomorphies of the seed surface and reduction of stigma lobes and anther cells (cf. Beardsley & Barker 2005).

### Ovary and fruit variation

The morphological distinction of *Hemichaena*, *Mimetanthe*, and *Diplacus* within Phrymaceae is remarkable — parietal placentation in this lineage (clade C) apparently is a specialization arising directly from axile placentation characteristic of the rest of the family (Fig. 2). These differences were described by Grant (1924) and Thompson (2005) and confirmed here. Presumably the development of parietal placentation has happened by (a) adnation of placenta to lateral walls, (b) loss of the septum, and (c) a shift in position of dehiscence. In distinguishing between *Erythranthe* and *Diplacus*, the difference in placentation provides an easily observed and unequivocal distinction.

In addition to the radical gynoecial modification in the *Diplacus* lineage, another has occurred in *Phryma*, which has a unilocular ovary (pseudo-monomerous, 2-carpellate with 1 carpel reduced developmentally) with a single ovule with basal placentation.

Two of the three main variants are shown in Figure 2.

- A Placentation axile, placentae fused in the basal half or for the whole length, remaining fused in fruit dehiscence, capsule dehiscence to base along outer suture or both sutures.
- B1 Placentation parietal, placentae separate (sometimes appressed but not fused), remaining attached to the walls and spread apart in fruit dehiscence, capsule dehiscence along the distal half of the inner (upper) suture to only distally along the outer (lower) suture.
- B2 Placentation parietal, placentae fused and also remaining attached to the walls, not spread apart in fruit dehiscence, capsule dehiscence along distal third of both sutures
- C Placentation basal, fruit indehiscent (achene)

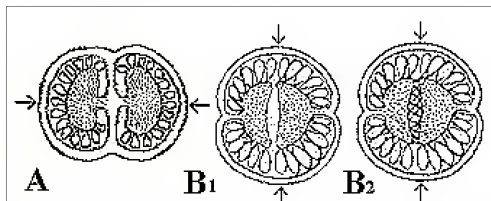


Figure 2 Representative ovary cross-sections (diagrammatic) Phrymaceae, not including *Phryma*. Arrows mark locations of dehiscence in capsules. A Placentation axile *Mimulus*, *Thyridia*, *Microcarpaea*, *Uvedalia*, *Peplidium*, *Elacholoma*, *Glossostigma*, *Leucocarpus*, and *Erythranthe*. B1 Placentation parietal *Hemichaena* and *Diplacus*. B2 Placentation parietal (placentae fused at least proximally) *Mimetanthe*. In *Phryma*, the ovary is unilocular and placentation of the single ovule is basal.

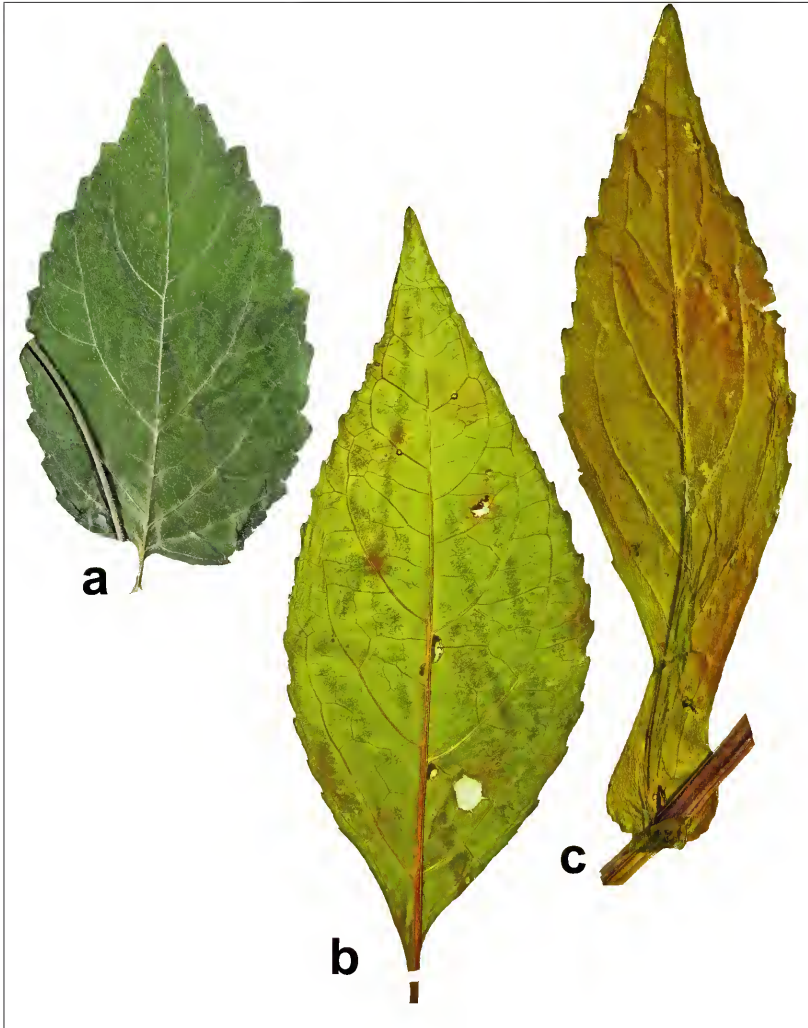


Figure 3. Leaf venation in Phrymaceae. A. **Mixed craspedodromous**: (a) *Phryma leptostachya*. B. **Weak brochidodromous**: (b) *Mimulus alatus*, (c) *Mimulus ringens*. Examples are not at the same size scale.

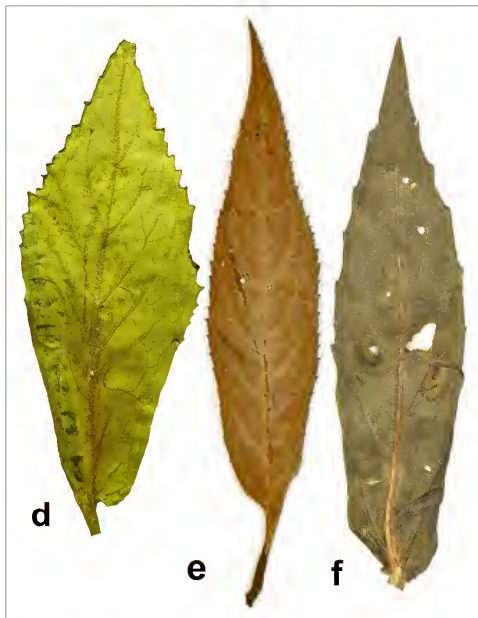


Figure 4. Leaf venation in Phrymaceae. Eucamptodromous: (d) *Hemichaena fruticosa*, (e) *Leucocarpus perfoliatus*, (f) *Erythranthe bracteosa*. Examples are not at the same size scale

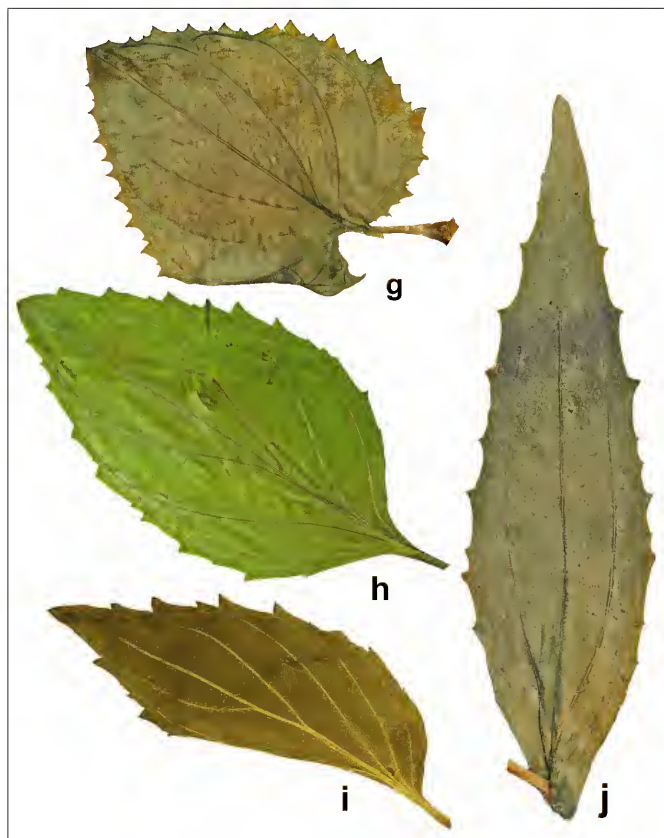


Figure 5. Leaf venation in Phrymaceae. Basal to near-basal acrodromous: (g) *Erythranthe decora*, (j) *Erythranthe nelsonii* (3-nerved). Suprabasal acrodromous to eucamptodromous: (h) *Erythranthe dentata*, (i) *Erythranthe sinocalba*. Examples are not at the same size scale.

### Leaf venation

Leaf venation in *Phryma* (Fig. 3a) seems best described as **mixed craspedodromous** (see Hickey 1973 for terms and definitions). It does not appear to be closely matched by any other Phrymaceae — rather it is more similar to the pattern often seen in mints and verbenas, where *Phryma* has traditionally been placed.

Venation is **acrodromous** in *Erythranthe*, *Diplacus*, and *Mimetanthe* and **eucamptodromous** (with more numerous suprabasal secondary veins, thus appearing pinnate) in *Leucocarpus* and *Hemichaena*, both patterns with the secondary veins arching convergently toward the apex and essentially remaining distinct their whole length. **Acrodromous** variants in *Erythranthe* and *Diplacus* have veins all basal (thus appearing palmate, Fig. 4c) or reduced to 1-nerved (**hyphodromous**) or 3-nerved in species with smaller leaves and even in larger leaves, as in Fig. 4f. When some veins tend to be suprabasal, venation appears to vary between palmate and subpinnate to pinnate (Figs. 5g, h, i). Even in the largest and longest leaves, secondary veins usually remain distinct, although an occasional connecting vein may develop.

The two North American species of *Mimulus* can be separated from *Erythranthe* and from Southern Hemisphere *Mimulus* *sensu stricto* by their **weak brochidodromous** leaf venation (Fig. 3b, c), with secondary veins weakly joining at the apices. It seems likely that this pattern is homologous with the essentially acrodromous/eucamptodromous pattern found in the rest of the family (except *Phryma*).

### Ecological terminology

The family occupies substrates that are permanently, seasonally, or briefly inundated in fresh water. *Aquatic* indicates that the plant begins and largely completes its life cycle in water. *Semi-aquatic* is used here to mean that a plant occupies seasonally or ephemerally aquatic habitats but persists on dried-out substrates where it completes its life cycle. *Terrestrial* means that the plant is not dependent on an initial submerged phase of the life cycle but may occur on moist exposed substrate.

### Treatments of the genera and sections

Descriptions of genera are consistent within the main lineages but may differ slightly between them where measurements are lacking for features not traditionally used diagnostically. However, we have tried to be consistent in important diagnostic characters.

Lists of species included for each section are separated by geography using traditional widely used geographical regions, but the boundaries of the Flora of North America North of Mexico are specially adopted.

Genera and infrageneric groups of former classifications often have a very different circumscription from the genera and sections of our classification (see above). As well as citing the protologue reference, in many instances we also cite literature in which other taxonomic circumscriptions were adopted (see Appendix).

## PHRYMACEAE Schauer in DC. Prod. 11: 520. 1847, nom. cons

**Annual or perennial herbs**, secondarily woody; iridoids absent, possibly sometimes present. **Leaves** opposite with margins entire or toothed, gland-dotted (punctate) or not. **Flowers** with hypogynous parts, in racemes, rarely solitary or in axillary clusters of 2–3; bracteoles absent. **Calyx** tubular, toothed, the tube ribbed or winged below teeth, rarely smooth. **Corolla** zygomorphic, rarely secondarily sub-actinomorphic, the limb with two upper lobes and 3 lower lobes or 5 equal lobes, rarely reduced to 3–4 lobes, sometimes with palate of variable form and color. **Stamens** 4, didynamous, rarely reduced to 2, with straight filaments arising from corolla tube, the anthers subreniform, with 2 confluent cells, rarely reduced by fusion to 1, with pollen trinucleate; <10-colpate; each colpus with 2 orae, or irregularly synaperturate ( $\pm$  spiraperturate, sect. *Simiola*, see Argue 1980). **Gynoecium**: nectary sometimes present; carpels 2, many-ovulate developing equally, rarely 1, single ovulate, the other vestigial, placentation axile, less often parietal, rarely sub-basal, the style terminal, the stigma 2-lobed, with lobes laminate, often sensitive, rarely (*Elacholoma hornii*) linear and probably not sensitive), sometimes the adaxial lobe shorter, sometimes reduced to a vestige. **Fruit** a loculicidal capsule, dehiscent, rarely fracturing, rarely a berry, borne in a persistent calyx. **Seeds** small, many, rarely 1 (in *Phryma*), surface reticulate and sometimes ribbed or winged, smooth, or tessellate; endosperm present or almost absent, cotyledons convolute.  $n = 7-10, 14, 22$ , etc. Native to the Americas, Asia, Africa, and Australasia.

Pollen, wood, chemical, seed anatomy, cotyledon, and chromosome details are taken from the family description in APG II (Stevens 2001 onwards).

In the main section, the statements of synonymy give only homotypic synonyms. In the Appendix, summaries of taxonomic usage of generic and infrageneric names in previous literature are provided.

## KEY TO THE GENERA OF PHRYMACEAE

- 1 Fruit a unilocular, 1-seeded achene; ovary 2-carpellate with 1 carpel reduced developmentally (pseudomonomerous) ..... 8 *Phryma*
- 1 Fruit a bilocular, many-seeded capsule or (*Leucocarpus*) a berry, ovary 2-carpellate
  - 2 Stigma 1-lamellate with a vestige of a second flap on the adaxial side of the style, anthers 1-celled
    - 3 Calyx not ribbed, 3–4-lobed, lobes unequal ..... 7 *Glossostigma*
    - 3 Calyx 5-angled, 5-lobed, lobes equal
      - 4 Leaves linear, sessile, blades herbaceous, not fleshy; calyx not fleshy, lobes recurved, sharply acute, ciliolate, capsules loculicidal, seeds reticulate ..... 3 *Microcarpaea*
      - 4 Leaves ovate to obovate to broadly obovate or spatulate, short-petiolate, the blade fleshy, calyx fleshy, lobes erect, bluntly acute to obtuse, glabrous or ciliolate, capsules loculicidal or tardily dehiscent by fracturing irregularly, seeds reticulate or ribbed with the ribs longitudinally rugose and with a row of areolae on each side ..... 5 *Peplidium*
  - 2 Stigma 2-lamellate or 2-fid (sometimes one flap reduced); anthers 2-celled
    - 5 Placentation parietal, fruits apically attenuate
      - 6 Flowers in bracteolate, axillary cymes, short-pedicellate; leaf venation eucamptodromous ..... 9 *Hemichaena*
      - 6 Flowers axillary and solitary, sessile to short-pedicellate or long-pedicellate, leaf venation acrodromous

7. Fruit walls densely pustulate-glandular, placentae fused at least in proximal half, pedicels longer than the calyx, calyces with midveins low-rounded (not angled or winged) ..... 10. **Mimetanthus**
7. Fruit walls glabrous or at least eglandular, placentae distinct, not fused, pedicels shorter than the calyx or essentially absent, calyces with midveins angled or wing-angled ..... 11. **Diplacus**
5. Placentation axile, fruits apically rounded to truncate.
8. Fruit a berry ..... 12. **Leucocarpus**
8. Fruit a loculicidal capsule.
9. Corollas subactinomorphic, pedicels shorter than the calyx; plants prostrate; stigma 2-flapped or 2-terete ..... 6. **Elacholoma**
9. Corollas bilabiate (sometimes secondarily subactinomorphic), pedicels mostly usually distinctly longer than the calyx, plants prostrate to erect, stigma usually 2-flapped
10. Leaves glandular-punctate; seeds ribbed, the ribs thick, longitudinally rugose, with a row of areolae along each side, plants semi-aquatic, prostrate or rarely erect herbs; capsules thick-walled, tardily dehiscent ..... 2. **Thyridia**
10. Leaves not glandular-punctate; seeds reticulate or tessellate, lacking ribs; plants terrestrial to semi-aquatic, mostly erect herbs, capsules thin-walled, readily dehiscent
11. Leaves 1-nerved ..... 4. **Uvedalia**
11. Leaves palmately veined to pinnately veined
12. Leaf venation weak brochidodromous (N. America) or basal acrodromous (S. Hemisphere), base chromosome number,  $x = 8, 11, 12$  ..... 1. **Mimulus**
12. Leaf venation basal acrodromous to suprabasal-acrodromous, base chromosome number,  $x = 14, 15, 16$  ..... 13. **Erythranthe**

**I. MIMULUS L., Sp. Pl. Sp. 2: 634. 1753. TYPE:** *Mimulus ringens* L. The genus as originally described by Linnaeus included only a single species.

*Monavia* Adans., *Fam. Plant.* 2: 211. 1763, nom. illeg. Superfluous when published, intended by Adanson as a replacement name for *Mimulus* L., which was listed as a synonym. Not *Mimulus* of Plinius, which was treated by Adanson as the name for *Rhinanthus* of Linnaeus. TYPE: *Mimulus ringens* L.

*Cynorrhynchium* J. Mitchell, *Diss. Brevis. Princ. Bot. Zool.* 29. 1769, nom. illeg. (includes type of an existing genus: ICN Art. 52.1). NEOTYPE (designated here): *Mimulus ringens* L. Although Pennell (1935, p. 112) wrote that the 1769 protologue "exactly repeated Mitchell's previous description in *Acta Phys.-Med. Acad. Caes. Leop.-Francisc. Nat. Cur.* 8: 207. 1748; only the genus was described, but by Linnaeus' reference in the *Genera Plantarum* [1754 (ed. 5), p. 283] to *Cynorrhynchium* as a synonym of *Mimulus*, Mitchell's plant was correctly identified with *M. ringens* L.," he did not effectively designate a neotype. The description by Linnaeus also incorporated much of the original by Mitchell.

Most of Mitchell's herbarium and types are in BM-Banks, with others in G, LINN, and OXF but a collection of *Mimulus* by Mitchell apparently is not among them.

*Mimulus* § *Erecti* Benth. in DC., *Prodr.* 10: 369. 1846, without indication of rank. LECTOTYPE (designated here): *Mimulus ringens* L. Bentham included, in part, *M. ringens*, *M. alatus*, *M. madagascariensis*, *M. gracilis*, *M. pusillus*, and *M. uvedaliae* in his taxon. There is no clear choice for lectotype; the species selected here is one that Bentham had studied from adequate material.

*Mimulus* § *Prostrati* Benth. in DC., *Prodr.* 10: 373. 1846, without clear indication of rank. LECTOTYPE (designated here): *Mimulus orbicularis* Wall. ex Benth. Bentham included *M. orbicularis*, *M. repens*, and *M. prostratus*. He noted that these comprised "Species Asiaticae



vel Australasicæ." This taxon has not been adopted subsequently or assigned a definite rank, and in global works these species have been consistently treated together. There is no clear choice for lectotype; the species selected here is one that Bentham had studied from adequate material.

*Mimulus* subg. *Synplacus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"). **LECTOTYPE** (designated here): *Mimulus ringens* L. Grant did not specify a type from among the four sections she included in subg. *Synplacus*. Typification of subg. *Synplacus* has not subsequently been made explicit and the subgenus has not been used to the exclusion of any sections or species among those with axile placentation. What species Grant may have had in mind as the type of subg. *Synplacus* is not clear — the choice here simply places the taxon as a synonym of *Mimulus sensu stricto*.

**Perennial**, rhizomatous, terrestrial or semi-aquatic. **Vestiture**: glabrous. **Stems** herbaceous, erect, 4-angled, winged in *M. alatus*. **Leaves** petiolate and thin-herbaceous (*M. alatus*) or fleshy (*M. orbicularis*), or sessile and semi-succulent, usually glandular-punctate, venation brochidodromous (*M. alatus*, *M. ringens*) or basal acrodromous (*M. aquatilis*, *M. strictus*) margins toothed. **Flowers** single, axillary at medial to distal nodes. **Fruiting pedicels** shorter or longer than calyces. **Fruiting calyces** erect, tube midveins angled to winged-angled. **Corollas** blue to violet, purplish, light pink, nearly white, or (*M. bracteosus*) yellow, deciduous, limbs strongly bilabiate and sagittally compressed. **Stamens** 4, anthers 2-celled. **Ovaries** 2-locular; **placentation** axile; **stigmas** bilamellate. **Fruits** many-seeded capsules with blunt or rounded to slightly emarginate apices, loosely enclosed in persistent calyx, included, bilocular, loculicidally dehiscent to base along outer suture or both sutures; **placentae** fused in the basal half or for the whole length, remaining fused in fruit dehiscence. **Seed** surface reticulate. **Chromosome numbers**,  $2n = 16, 22, 24$ . **Species** 7.

(FNAMM)

1. ***Mimulus alatus*** Sol ex Ait., Hort. Kew 2: 361. 1789

2. ***Mimulus ringens*** L., Sp. Pl. 2: 634. 1753.

a. *Mimulus ringens* var. ***ringens***

b. *Mimulus ringens* var. ***colpophilus*** Fernald, Rhodora 34: 119. 1932.

(AUSTRALIA)

3. ***Mimulus gracilis*** R. Br., Prodr. Fl. Nov. Holland 439. 1810.

4. ***Mimulus aquatilis*** A. R. Bean, Austrobaileya 6: 550. 2003. (See comments below.)

(AFRICA, MADAGASCAR, INDIA)

5. ***Mimulus strictus*** Benth., Scroph. Ind. 28. 1835. India, Africa

*Mimulus angustifolius* Hochst. ex A. Rich., Tent. Fl. Abyss. 2: 119. 1850.

6. ***Mimulus madagascariensis*** Benth. in DC., Prodr. 10: 369. 1846. Madagascar

*Limnophila toremodes* Baker, J. Bot. 20: 221. 1882.

(ASIA)

7. ***Mimulus orbicularis*** Wall. ex Benth., Scroph. Ind., 29. 1835. Vietnam, Cambodia, Laos, Thailand, Myanmar. See comments below, under *Pepidium*.

Material of *Mimulus gracilis* from Australia differs from the dozen African and Indian specimens seen in its finer stems, finer roots, smaller, narrower, entire or almost entire leaves with a cuneate base, and its calyces densely pubescent inside and shortly lobed (Barker pers. obs.). This coincides with Pennell's (1943) observations. Pennell considered that the African-Indian plant might differ by its white or pale blue corollas from the blue-purple corollas of the Australian species, but it is based on limited observation. Pennell's resurrection of *M. strictus* for African and Indian

occurrences of *M. gracilis* has generally gone unrecognized but was followed by Yamazaki (1985) for Indo-China.

Only *Mimulus ringens* and *M. gracilis* have been subject to molecular analysis and they form the basis for the phyletic position of this group. The morphological and molecular attributes of the other species retained in *Mimulus* sensu stricto are being reviewed as they show quite different leaf and/or floral attributes. *Mimulus madagascariensis* is very different in leaf morphology, while the floating aquatic *M. orbicularis* has ecological and morphological aspects of *Peplidium* (Barker pers. obs.). Bean (2003) hypothesized that *M. aquatilis* of northeastern Australia is closely related to *M. gracilis*, but while included here, its sessile, palmately veined leaves seem out of place in narrowly defined *Mimulus* (Nesom pers. obs.). A relationship of *M. aquatilis* with *Erythranthe* sect. *Sinopitheca* might be suspected, but the Australian geography and punctate leaves of *M. aquatilis* are out of place in *Erythranthe*.

Despite the different chromosome numbers of the two American species (*Mimulus ringens*,  $2n = 16, 24$ ; *M. alatus*,  $2n = 22$ ) and strikingly different morphology, these two have been reported to form natural hybrids (Windler et al. 1976).

## II. THYRIDIA W.R. Barker & Beardsley, gen. nov. TYPE: *Thyridia repens* (R. Br.) W.R. Barker & Beardsley

**Validating diagnosis.** A new genus differing from *Mimulus* sensu stricto by its ribbed seeds with a row of window-like areolae on each side of the ribs and from species of *Peplidium* with similar seeds by its bilabiate corolla with closed palate, its 2-celled anthers, and its bilamellate stigma.

Annual or perennial, semi-aquatic herbs, not rhizomatous. Vestiture: glabrous. Stems usually prostrate, rooting at nodes and forming mats, when submerged erect to 20 cm high and/or with erect branches arising from prostrate parts. Leaves semi-succulent, ovate to elliptic-oblancoate, 2–6 mm, hyphodromous (1-nerved), sessile to subsessile, often cordate, distinctly glandular-punctate, margins entire. Flowers single, axillary in sporadic nodes, subsessile to pedicellate. Fruiting pedicels short to long. Calyces 3–5 mm long, ribbed, lobes shortly deltate. Corollas blue-purple, with a white and yellow palate; tube-throats funnellform, 5–7(–10) mm, limbs bilabiate, mouth closed by palate. Stamens 4; anthers 2-celled. Ovaries 2-locular; placentation axile; stigma bilamellate. Fruits loculicidally dehiscent, thick-walled capsules. Seed surface thick-ribbed, the ribs with a row of areolae along each side. Chromosome number,  $2n = 20$ . Species 1. Australia, New Zealand.

1. *Thyridia repens* (R. Br.) W.R. Barker & Beardsley, **comb. nov.** *Mimulus repens* R. Br., Prodr Fl Nov. Holland 432. 1810.  
*Mimulus colensoi* Kirk, Trans & Proc New Zealand Inst 3: 179. 1871.

The generic name is derived from the Greek *thyris* (diminutive *thyridios*, denoting small door or window; Brown 1956), alluding to the row of window-like areolae along either side of the longitudinal ribs of the seed surface.

*Thyridia* has the floral parts of *Mimulus* sensu stricto, with a 5 ribbed tubular calyx, bilabiate corolla with a closed palate, didynamous anthers with 2 confluent cells, and a bilobed stigma. Separating it, however, are its gland-dotted fleshy leaves and its distinctive seed that has broad ribs with fine longitudinal lines on the outer face; these ribs have a row of areolae each side. These seed features are surely highly derived compared with the reticulate seed of *Mimulus* sensu stricto and *Microcarpaea*, *Elacholoma*, *Glossostigma* and elsewhere in the family. Similar seeds are also found

in some species of *Peploidium*, including *P. foecundum* W.R. Barker and several unnamed species. Gland-dotted fleshy leaves are found in other unnamed *Peploidium* species.

**III. MICROCARPAEA** R. Br., Prodr. Fl. Nov. Holland., 435. 1810. **TYPE:** *Microcarpaea muscosa* R. Br., nom. illeg. (= *Microcarpaea minima* (K.D. Koenig ex Retz.) Merrill), the only species in the protologue.

Semi-aquatic, annual, not rhizomatous, glabrous herbs. **Vestiture:** glabrous to sparsely eglandular hairy. **Stems** prostrate to procumbent, to over 10 cm long. **Leaves** sessile, hyphodromous or suprabasal acrodromous (3-nerved), not glandular-punctate, margins entire. **Flowers** axillary at medial to distal nodes, sessile to subsessile, rarely long pedicellate. **Fruiting pedicels** short to long. **Calyces** 2–3 mm, 5-ribbed, with 5 lobes spreading-reflexing at maturity. **Corollas** tiny, tube-throats cylindric, 1.5–2.3 mm, barely or not at all exerted from calyx. **Stamens** 2; anthers 1-celled. **Ovaries** 2-locular; **placentation** axile; **stigma** unilamellate through reduction of adaxial lobe to a vestige. **Fruits** bilocular, loculicidally dehiscent, thin-walled capsules; septum splitting down midline, each part attached to the valve. **Seed** surface reticulate. **Chromosome number** unknown. **Species** 2.

*Microcarpaea minima* is widespread — occurring in China, Taiwan, India, Indonesia, Japan, Korea, Malaysia, Thailand, Vietnam, and Australia — while *Microcarpaea agonis* is endemic to Queensland, Australia.

1. *Microcarpaea minima* (K.D. Koenig ex Retz.) Merrill, Philipp. J. Sci. 7: 100. 1912. *Paederota minima* K.D. Koenig ex Retz, Obs. Bot. 5: 10. 1788.

*Microcarpaea muscosa* R. Br., Prodr. Fl. Nov. Holland. 435. 1810, nom. illeg.

2. *Microcarpaea agonis* A.R. Bean, Austrobaileya 5: 149. 1997.

**IV. UVEDALIA** R. Br., Prodr., 440. 1810. **TYPE:** *Uvedalia linearis* R. Br., the only species in the protologue.

Terrestrial, annual herbs, not rhizomatous. **Vestiture:** stems, pedicels, and calyces glabrous or sparsely to densely hispidulous. **Stems** erect, 5–30 cm tall. **Leaves** herbaceous to semi-succulent, linear-lanceolate, 5–11 mm, sessile, hyphodromous or basal acrodromous, not glandular-punctate, sometimes sparsely hispidulous, margins entire. **Flowers** single, axillary in distal nodes, pedicellate. **Fruiting pedicels** 15–40 mm. **Calyces** semi-succulent, 5–7 mm, lobes shortly deltate-apiculate. **Corollas** yellow or blue with a yellow throat, sometimes red-dotted, tube-throats 4–7 mm, limbs bilabiate, throat open or closed by palate. **Stamens** 4; anthers 2-celled. **Ovaries** 2-locular; **placentation** axile; **stigma** bilamellate. **Fruits** loculicidally dehiscent, thin-walled capsules. **Seed** surface tessellate. **Chromosome number** unknown. **Species** 2. Australia, ?Papua New Guinea, Timor.

1. *Uvedalia linearis* R. Br., Prodr. Fl. Nov. Holland., 440. 1810. *Mimulus linearis* (R. Br.) Wettst., Nat. Pflanzenfam. [Engl. & Prantl] 4(3b): 72. 1891 [non *Mimulus linearis* Benth. 1835].

*M. uvedaliae* Benth. in DC., Prodr. 10: 369. 1846.

**a. *Uvedalia linearis* var. *linearis***

*Mimulus uvedaliae* var. *uvedaliae* Benth., Fl. Austral. 4: 482. 1869.

**b. *Uvedalia linearis* var. *lutea* (Benth.) W.R. Barker & Beardsley, **comb. nov.** *Mimulus uvedaliae* var. *lutea* Benth., Fl. Austral. 4: 482. 1869.**

*M. debilis* F. Muell., Trans. Phil. Soc. Vict. 3: 62. 1859.

2. *Uvedalia clementii* (Domin) W.R. Barker & Beardsley, **comb. nov.** *Mimulus clementii* Bibliot. Bot. Heft 89, 595. 1929.

The plant tentatively recognized by Beardsley and Barker (2005) as "*Mimulus* sp. *Pilbara*" (W.R. Barker 7335) is identified here as *Uvedalia clementii*.

This group of species has not been distinguished as a genus separate from *Mimulus* for almost 200 years. *Uvedalia*, well-defined on vegetative, floral and seed characters, is under revision by Barker and contains new species, two of which (Beardsley & Barker 2005) he has given informal phrase names: *U. sp. Open papillose throat* (W.R. Barker 8004) and *U. sp. Small white flower* (W.R. Barker 8001).

V. **PEPLIDIUM** Delile, Fl. Égypte [Edn. 1]: 148. 1813 [Delile, Descr. Égypte, Hist. Nat. 2: 50. 148. 1813 ("1812"), nomen nudum]. TYPE: *Peplidium humifusum* Delile (= *Peplidium maritimum* (L.f.) Asch.), the only species in the protologue.

Terrestrial or semi-aquatic, perennial or annual herbs, not rhizomatous. Vestiture: glabrous or sparsely to densely eglandular hairy. Stems prostrate. Leaves semi-succulent, ovate to circular, 3–12 mm, sessile, subsessile or petiolate, the blade floating, fleshy, glandular-punctate, basal or suprabasal acrodromous or hyphodromous. Flowers 1–3, axillary in medial to distal nodes, subsessile to pedicellate. Fruiting pedicels short to long. Calyces tubular, ribbed, ca. 3–5 mm, lobes acute or sub-acute. Corollas white to blue-purple, tube-throats cylindric, angled upwards or erect, the limb, the mouth open, sometimes with a palate; limb spreading, prominent, rarely short and suberect, 2-lipped or sub-actinomorphic. Stamens 4 or 2, anthers 1-celled. Ovaries 2-locular; placentation axile; stigma unilamellate, through reduction of adaxial lobe to a vestige, usually irritable, covering the front of the corolla tube. Fruits bilocular, loculicidally dehiscent or tardily dehiscent capsules. Seed surface reticulate or thick-ribbed, the ribs with a row of areolae on each side, sometimes some ribs wing-like. Chromosome number unknown. Species 4. Mostly subtropical, arid and semi-arid Australia, with *P. maritimum* extending to North Africa, India.

1. *Peplidium aithocheilum* W.R. Barker, J. Adel. Bot. Gard. 13: 88. 1990
2. *Peplidium focundum* W.R. Barker, J. Adel. Bot. Gard. 15: 71. 1992
3. *Peplidium maritimum* (L.f.) Asch., Betrag. Fl. Aethiop. 275. 306. 1867. *Hedyotis maritima* L.f., Suppl. Pl. 119. 1781 [1782].  
*P. humifusum* Delile, Fl. Egypte [Edn. 1]: 148. 1813, [Delile, Descr. Egypte, Hist. Nat. 50. 1813 ("1812"), nomen nudum].
4. *Peplidium muelleri* Benth., Fl. Austral. 4: 500. 1868

*Peplidium* shares with *Microcarpaea* and *Glossostigma* single-celled anthers and a unilamellate stigma derived by the reduction of the adaxial lamella to a small vestige. The single lamella is generally irritable except in the very small flowered species which from the low pollen-ovule ratios are apparently obligately autogamous (Barker 1982). Revisional studies (Barker in prep.) indicate at least 14 species, with a number of phrase names designated by Barker for interim use (Beardsley & Barker 2005): *P. sp. Tanami* (W.R. Barker 2819), *P. sp. Yelma* (R.J. Chinnock 4620), *P. sp. Harding Dam* (W.R. Barker 7357), *P. sp. Marla* (W.R. Barker 3535), *P. sp. Banyawarn* (R.J. Chinnock 745), *P. sp. Pilbara* (W.R. Barker 7285), *P. sp. Recurved limb* (W.R. Barker 7246) and *P. sp. Closed lips* (W.R. Barker 7324).

VI. **ELACHOLOMA** F. Muell. & Tate ex F. Muell., Vict. Naturalist 12: 14. May 1895 [F. Muell. & Tate ex Tate, Trans. Roy. Soc. S. Austral. 19: 79. July 1895, nomen nudum]. TYPE: *Elacholoma hornii* F. Muell. & Tate, the only species in the protologue.

Terrestrial or semi-aquatic, annual herbs, not rhizomatous. Vestiture: leaves sparsely to densely minutely scabrous-hispidulous to hispid with eglandular hairs along the margins or all over. Stems prostrate. Leaves semi-succulent, linear-oblong to linear-oblancoate, 3–12 mm, sessile, not glandular-punctate, hyphodromous. Flowers single, axillary at medial to distal nodes, subsessile to pedicellate. Fruiting pedicels to ca. 10–15 mm long. Calyces tubular, 1–3 mm., ribbed, lobes

deltoid. Corollas white or blue-purple, tube-throats cylindric, limb expanded or not. Stamens 4 or 2; anthers with 2 confluent cells. Ovaries 2-locular; placentation axile; stigma bilobed, the lobes lamellate or filiform. Fruits bilocular, loculicidally dehiscent capsules. Seed surface reticulate. Chromosome number unknown. Species 2. Arid Australia.

1. *Elacholoma hornii* F. Muell. & Tate, Vict. Naturalist 12: 14. 1895

2. *Elacholoma prostrata* (Benth.) W.R. Barker & Beardsley, **comb. nov.** *Mimulus prostratus* Benth. in DC., Prodr. 10: 373. 1846

*M. pusillus* Benth. in DC., Prodr. 10: 369. 1846.

The genus also contains an undescribed species. *Elacholoma* sp. *Showy flowers* (C.P. Campbell 1762) (fide Beardsley & Barker 2005) will be formally described by W.R. Barker and M. Hislop now that generic placement is finalized.

The flowers of this genus furnish synapomorphies, notably the actinomorphic corolla and a forward-directed bilobed stigma centrally positioned in the corolla. *Elacholoma prostrata* retains the bilamellate stigma of *Mimulus* sensu stricto, *Thyridia*, and the American-Asian clade, but *E. hornii* and *E. sp. Showy flowers* differ by their filiform exserted stigmas, which are unique in Phrymaceae and across families now segregated from the traditional Scrophulariaceae. This presumably reflects a shift to lepidopteran pollination evident also in the long corolla tube in the latter species. These two species are better combined as a single monophyletic genus, emphasizing their close monophyletic relationship (Beardsley & Barker 2005).

VII. GLOSSOSTIGMA Wight & Arn., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 18: 355. 1836, nom. cons. TYPE: *Glossostigma spathulatum* Arn., nom. illeg. (*Limosella diandra* L. = *Glossostigma diandrum* (L.) Kuntze), the only species in the protologue.

*Tricholoma* Benth. in DC., Prodr. 10: 426. 1846, nom. rejic. TYPE: *T. elatinoides* Benth. = *G. elatinoides* (Benth.) Benth. ex J.D. Hook., non *Tricholoma* (Fr.) Staude, nom. cons. (Fungi: Agaricaceae), the only species in the protologue.

Semi-aquatic or aquatic small to tiny, annual herbs, sometimes rhizomatous, sometimes forming mats. Vestiture: glabrous. Stems repent, on wet mud, often rooting at nodes. Leaves linear-oblong to spatulate, blades obovate to elliptic, fleshy, 2–8 mm, not glandular-punctate, hyphodromous, margins entire, base attenuate to subpetiolate. Flowers single, axillary, in medial to distal nodes, subsessile to pedicellate. Fruiting pedicels 0 to ca. 100 mm long. Calyces 1–2.5 mm, zygomorphic, not ribbed or winged, lobes 3–4, unequal, obtuse. Corollas white or blue- or red-purple, with a white or yellow mouth, tube-throats 1–1.5 mm, stamens inserted near mouth, limb 2-lipped or sub-rotate. Stamens 4 or 2, 1-celled. Ovaries 2-locular, placentation axile; stigma unilamellate through adaxial lobe reduced to vestige, usually irritable. Fruits bilocular, loculicidally dehiscent capsules, sometimes (*G. cleistanthum*) when plant aquatic thick-walled and indehiscent, becoming thin on drying of substrate. Seed surface reticulate. Chromosome number unknown. Species 5. Mainly Australia and New Zealand, with *G. diandrum* extended into India, Indochina, and apparently southern Africa (though it is only known from the type of *G. diandrum* purported to come from the Cape of Good Hope), and since 1992 recorded as naturalized in eastern North America (e.g., Les et al. 2006; *G. cleistanthum*).

1. *Glossostigma cleistanthum* W.R. Barker, J. Adel. Bot. Gard. 15: 72. 1992

2. *Glossostigma diandrum* (L.) Kuntze, Rev. Gen. Plant. 1: 461. 1891. *Limosella diandrum* L., Mant. Plant. 1: 252. 1767.

*G. submersum* Petrie, Trans. & Proc. N. Zeal. Inst. 23: 401. 1891

3. *Glossostigma drummondii* Benth. in DC., Prodr. 10: 426. 1846. *Limosella drummondii* (Benth.) F. Muell., Fragm. Phyt. Austral. 6: 104. 1868

4. *Glossostigma elatinoides* (Benth.) Benth. ex J.D. Hook., Bot. Antarct. Voy. II. (Fl. Nov.-Zel.) 189. 1853. *Tricholoma elatinoides* Benth. in DC., Prodr. 10: 426. 1846.
5. *Glossostigma trichodes* F. Muell., Vict. Nat. 9: 128. 1893.

Revisionary studies (Barker in prep.) define at least eight species, with two given phrase names: *G. sp. Large flowered* (W.R. Barker 7277) and *G. Long stout pedicelled* (W.R. Barker 2481) (cf. Beardsley & Barker 2005).

- VIII. PHRYMA L., Sp. Pl. 2: 601. 1753. *Leptostachya* Adans., Fam. 2: 201. 1763 (superfluous replacement name for *Phryma* L.). TYPE: *Phryma leptostachya* L., the sole species in the protologue.

Perennial, rhizomatous, terrestrial. Vestiture: glabrous to minutely puberulent, eglandular. Stems herbaceous, erect, 4-angled. Leaves petiolate, herbaceous, not glandular-punctate venation brochidodromous. Flowers ca. 20–40, subopposite, sessile to subsessile in terminal and axillary spikes, bracts and bracteoles greatly reduced and inconspicuous. Fruiting pedicels absent or nearly so. Fruiting calyces strongly reflexed and appressed to the inflorescence axis, tube midveins ribbed. Corollas white to pinkish or reddish to violet, tardily marcescent, limbs bilabiate. Stamens 4, anthers 2-celled. Ovaries 1-locular (pseudomonomerous, 2-carpellate with 1 carpel reduced developmentally); placentation basal; stigmas bilamellate. Fruits 1-seeded achenes, enclosed in persistent calyx, unilocular, indehiscent. Seed surface not evident (the integument breaks down during fruit maturation, finally reduced to a cuticular layer within the mature fruit). Chromosome number,  $2n = 28$ . Species 1.

Whipple (1972) has a brief summary of the classification history of *Phryma*. It was first segregated at the rank of family by Schauer (1847), who emphasized the distinctive gynoeceal features in distinguishing it from Verbenaceae. Fruit development suggested to Whipple that the uniovulate, uniloculate gynoeceum is derived from a similar fruit type found in Verbenaceae-Lantaneae — as in *Phryma*, the abaxial carpel is suppressed in *Lantana*, *Lippia*, and *Stachytarpheta*. She also observed that floral vascularization in *Phryma* and these three genera is basically alike.

(FNANM, ASIA)

1. *Phryma leptostachya* L., Sp. Pl. 601. 1753.

*Phryma leptostachya* var. *asiatica* H. Hara, Enum. Spermatoph. Jap. 1: 297. 1948. *Phryma leptostachya* subsp. *asiatica* (H. Hara) Kitam., Acta Phytotax. Geobot. 17: 7. 1957. *Phryma asiatica* (H. Hara) O. Deg. & I. Deg., Phytologia 22: 212. 1971.

*Phryma* includes populations disjunct between eastern North America and southeastern Asia. These have been variously treated as two races, varieties, or separate species (Thieret 1972; Whipple 1972; Lee et al. 1996; Cantino 2004; Deyuan & Wen 2011). The disjunct plants show distinct molecular divergence but no morpho-geographic groups at the intercontinental level (Nie et al. 2006).

- IX. HEMICHAENA Benth., Pl. Hartw., 78. 1841. TYPE: *Hemichaena fruticosa* Benth. (= *Mimulus fruticosus*).

*Mimulus* sect. *Tropanthus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 324. 1925 ("1924"). TYPE: *Mimulus treleasei* A.L. Grant (= *Mimulus levigatus*), the only species in the protologue.

*Berendtia* A. Gray, Proc. Amer. Acad. Arts 7: 379. 1868 (non Goeppert 1845). *Berendtiella* Wettst. & Harms in Engl. & Prantl, Pflanzenfam. II-IV: 459. 1899. [a replacement name for *Berendtia* A. Gray]. LECTOTYPE (Thieret 1972b, p. 92): *Berendtia ghiesbreghtii* A. Gray (= *Mimulus rugosus*). Gray did not cite a type for his new genus, in which he included *B. ghiesbreghtii*, *B. coulteri*, and *B. rugosa*.

Plants perennial, rhizomatous or woody-taprooted. Vestiture: viscid-pilose or glabrous. Stems woody, terete, erect or prostrate-creeping, terete. Leaves petiolate, herbaceous, not glandular-punctate, venation eucamptodromous. Flowers 1–5(–12) in bracteolate axillary cymes. Fruiting pedicels shorter to about equal or slightly longer than the calyces. Fruiting calyces erect, low-plicate. Corollas red or yellow, marcescent, limbs bilabiate. Stamens 4, anthers 2-celled. Ovaries 2-locular; placentation parietal; stigmas bilamellate. Fruits many-seeded capsules with rounded apices, stipitate-glandular, loosely enclosed in persistent calyx, included, bilocular, loculicidally dehiscent along both sutures to the base. Seed surface tessellate. Chromosome number unknown. Species 5.

(MEXICO, CENTRAL AMERICA)

1. *Hemichaena coulteri* (A. Gray) Thieret, Fieldiana, Bot. 34: 94. 1972. *Berendtiella coulteri* A. Gray, Proc. Amer. Acad. Arts 7: 380. 1868. *Berendtiella coulteri* (A. Gray) Thieret, Ceiba 4: 305. 1955. *Mimulus coulteri* (A. Gray) G.L. Nesom, Phytoneuron 2011-28: 7. 2011.
2. *Hemichaena fruticosa* Benth., Pl. Hartw., 78. 1841. *Leucocarpus fruticosus* (Benth.) Benth. in DC., Prodr. 10: 336. 1846. *Mimulus fruticosus* (Benth.) G.L. Nesom, Phytoneuron 2011-28: 5. 2011.
3. *Hemichaena levigata* (B.L. Rob. & Greenm.) Thieret, Fieldiana, Bot. 34: 96. 1972. *Berendtiella levigata* B.L. Rob. & Greenm., Proc. Amer. Acad. Arts 32: 39. 1897. *Berendtiella levigata* (B.L. Rob. & Greenm.) Thieret, Ceiba 4: 305. 1955. *Mimulus levigatus* (B.L. Rob. & Greenm.) G.L. Nesom, Phytoneuron 2011-28: 6. 2011.
- Mimulus treleasei* A.L. Grant, Ann. Missouri Bot. Gard. 11: 325. 1925 ("1924").
4. *Hemichaena spinulosa* (S. Watson) Thieret, Fieldiana, Bot. 34: 98. 1972. *Berendtiella spinulosa* S. Watson, Proc. Amer. Acad. Arts 25: 159. 1890. *Berendtiella spinulosa* (S. Watson) Thieret, Ceiba 4: 305. 1955. *Mimulus spinulosus* (S. Watson) G.L. Nesom, Phytoneuron 2011-28: 6. 2011.
5. *Hemichaena rugosa* (Benth.) Thieret, Fieldiana, Bot. 34: 96. 1972. *Diplacus rugosus* Benth. in DC., Prodr. 10: 368. 1846. *Berendtiella rugosa* (Benth.) A. Gray, Proc. Amer. Acad. Arts 7: 380. 1868. *Berendtiella rugosa* (Benth.) Thieret, Ceiba 4: 305. 1955. *Mimulus rugosus* (Benth.) G.L. Nesom, Phytoneuron 2011-28: 7. 2011.

In uniting the 5 species of *Berendtiella* and *Hemichaena* (all as *Hemichaena*), Thieret (1972b, p. 89) observed that "The genera *Leucocarpus*, *Berendtiella*, and *Hemichaena* possess floral characteristics that indicate their alliance with *Mimulus* and so have been transferred to the Gratiolaceae. These three genera are rather similar in certain vegetative features and in inflorescence, suggesting close affinity." *Leucocarpus* and *Hemichaena* were formally brought into *Mimulus* (Nesom 2011) with the intent of using *Mimulus* as the name for the western North American and Central American species, an idea relinquished here.

The woody-stemmed, shrubby habit of *Hemichaena* has developed in parallel in *Diplacus* sect. *Diplacus*, and the mix of red and yellow corolla colors also is encountered within other sections of *Diplacus*. The axillary cymoid inflorescences of *Hemichaena* also are produced by *Leucocarpus perfoliatus*. In the context of the phylogeny shown in Figure 1, these complex structures are hypothesized to be specialized and developed in parallel within Phrymaceae.

- X. MIMETANTHE Greene, Bull. Calif. Acad. Sci. 1: 181. 1886[1885]. TYPE: *Mimetanthus pilosa* (Benth.) Greene

*Herpestis* sect. *Mimuloides* Benth. in DC., Prodr. 10: 394. 1846. *Mimulus* § *Mimuloides* (Benth.) Benth. & J.D. Hook., Gen. Pl. 2(2): 947. 1876. TYPE: *Herpestis pilosa* Benth. [= *Mimetanthus pilosa*] Watson (1871) noted that the species had been recognized as *Herpestis* sect. *Mimuloides* but he did not formally transfer the section to *Mimulus*.

Annual, fibrous-rooted or taprooted, terrestrial. Vestiture: stems, leaves, and calyces prominently glandular-villous. Stems herbaceous, terete, erect. Leaves sessile, herbaceous, not

glandular-punctate 1-veined (hyphodromous) or weakly 3-veined (basal acrodromous). Flowers single, axillary, usually racemose. Fruiting pedicels about equal to the calyces in length or slightly longer. Fruiting calyces erect, becoming swollen-ovoid in fruit, midveins low-rounded (not angled or winged), lobes strongly unequal. Corollas yellow with 2 purple spots on ventral lip, marcescent to quickly deciduous, limbs slightly to strongly bilabiate. Stamens 4, anthers 2-celled. Ovaries 2-locular; placentation parietal; stigmas bilamellate. Fruits many-seeded capsules with attenuate apices, minutely and densely pustulate-glandular, loosely enclosed in persistent calyx, included or slightly exerted, bilocular, loculicidally dehiscent along the distal 1/3–1/2 of both sutures, placentae fused and also remaining attached to the walls or sometimes dividing in the distal 1/3–1/2, both valves in dehiscence spreading-reflexing in so far as separated. Seed surface reticulate, minutely glandular. Chromosome number apparently unknown. Species 1.

(FNANM, MEXICO)

1. *Mimetanthe pilosa* (Benth.) Greene, Bull. Calif. Acad. Sci. 1: 181. 1885. *Herpestis pilosa* Benth., Companion Bot. Mag. 2: 57. 1836. *Mimulus pilosus* (Benth.) S. Watson, Bot. 40th Parallel, 225. 1871. *Mimulus exilis* Durand & Hilg., Pl. Heermannianae 43. 1854 [Nov 1854], J. Acad. Nat. Sci. Philadelphia, n.s., 3: 43. May 1855.

This species has been segregated in the past as the monotypic genus *Mimetanthe* Greene and has been treated as such by Grant (1924) and other botanists (e.g., Holmgren 1984) but not by Pennell (1951), Munz (1959), or Thompson (1993, 2005). Bentham originally described *Mimulus pilosus* in the genus *Herpestis* Gaertn. (1807), but *Herpestis* is now regarded as a synonym of *Bacopa* Aubl.

Parietal placentation and apically attenuate fruits without prismatic or angled walls are synapomorphic within *Diplacus*. As a result the species could justifiably be included within *Diplacus* as sister to the rest of the genus. The decision to maintain it as a separate genus is subjective, but the species has unique specializations in pollen morphology (Argue 1980, 1984) and floral morphology that have been emphasized by previous botanists; the fusion of its parietal placentae is another specialization apparently not encountered in any species of *Diplacus*. Gray (1886, p. 279) noted this: "Annual, with corolla of *Eumimulus*, capsule with the divided placentae of *Eunamus*, but the calyx campanulate and 5-cleft; its tube not prismatic nor even carinate-angled, but almost nerveless; its lobes plane."

Greene (1885, p. 122) included the species within *Mimulus*, describing it thus: "A soft-hairy, pale-green, Californian annual, uniting the characters partly of *Herpestis* and partly of *Eunamus*, with a habit which is not that of either of those genera, nor yet of *Mimulus*. Very likely it were better disposed of as a generic type, as was long ago suggested, but not carried into effect, by Durand & Hilgard." Very shortly thereafter, Greene (1885) formally segregated it as *Mimetanthe*, with these comments (p. 181): "The peculiar dehiscence, with the singular bending back of the valves, will hardly be observable in herbarium specimens, which are almost always too young to show it; but in autumn or midwinter, when the foliage and calyces are decayed, and the capsules alone persist upon the dead stems and branches, this character becomes conspicuous."

The isolated taxonomic position of this species is recognized here but it is clear that further morphological and molecular work needs to be done to confirm its sister relationship to *Diplacus*. The current position is not supported based on the analysis presented in Beardsley et al. (2004, Fig. 1).

- XI. *DIPLACUS* Nutt., Ann. Nat. Hist. 1: 137. 1838. *Mimulus* [unranked] *Diplacus* (Nutt.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876 [*Mimulus* sect. *Diplacus* (Nutt.) Benth. & J.D. Hook., Gen. Pl. 2(2): 947. 1876]. LECTOTYPE (Thompson 2005): *Diplacus glutinosus* (J.C. Wendl.) Nutt. [= *Diplacus aurantiacus*].



*Mimulus* subg. *Schizoplacus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924").  
LECTOTYPE: (Thompson 2005, p. 26): *Mimulus namus* Hook. & Arn. [= *Diplacus namus*].

**Annual** (fibrous-rooted or slender taprooted) or **perennial** (taprooted or, in one species, rhizomatous), terrestrial. **Vestiture**: puberulent-glandular to villous-glandular or puberulent to softly hirsute or villous and non-glandular, less commonly glabrous. **Stems** herbaceous or woody, erect, terete. **Leaves** petiolate or sessile, herbaceous, not glandular-punctate, venation acrodromous (suprabasal basal) to hypohodromous. **Flowers** single, axillary, often appearing sessile from the basal rosette because of foreshortened nodes. **Fruiting pedicels** absent or at least usually distinctly shorter than the calyx. **Fruiting calyces** erect, tube midveins plicate-raised or angle- to rounded-redged. **Corollas** yellow, white, white with purple patterning, pink, purple to light violet, red, orange, marcescent (sometimes deciduous in *D. pictus* and *D. mohavensis*), limbs bilabiate to regular. **Stamens** 4, anthers 2-celled. **Ovaries** 2-locular; **placentation** parietal; **stigmas** bilamellate. **Fruits** many-seeded capsules with attenuate apices, glabrous, loosely enclosed in persistent calyx, often slightly exserted, bilocular, loculicidally dehiscent (initially indehiscent in sect. *Oenoe*) along the distal half of the inner (upper) suture to only distally along the outer (lower) suture. **Seed** surface reticulate to nearly smooth. **Chromosome numbers**  $2n = 16, 18, 20$ . **Species** 46.

The attenuate tips of the capsule valves are usually exserted from the calyx and often form a chute-like passage for the seeds during dispersal. In sect. *Oenoe*, the initially indehiscent fruits open along the inner suture after being wet by fall or winter rains, long after senescence.

1. **DIPLACUS** sect. **EREMIMIMULUS** G.L. Nesom & N.S. Fraga, **sect. nov.** TYPE: *Diplacus parryi* (A. Gray) G.L. Nesom & N.S. Fraga

**Annual** (*D. parryi*) or **perennial** (*D. rupicola*), puberulent to softly hirsute, glandular; leaves mostly basal or near-basal on short stems, blades narrowly lanceolate to lanceolate or oblanceolate, pinnately to subpinnately veined; flowers usually 2 per node; pedicels usually shorter than calyces, sometimes nearly subequal; corollas rotate and nearly radial, persistent, lobes whitish to pink (*D. rupicola*) or purple to yellow (*D. parryi*) with yellow ventral ridges; anthers glabrous; styles glandular pubescent, stigma lobes equal; fruits dehiscent (tardily in *D. rupicola*).  $x = 8$ .

(FNANM)

1. **Diplacus parryi** (A. Gray) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus parryi* A. Gray, Proc. Amer. Acad. Arts 11: 97 1876.

2. **Diplacus rupicola** (Coville & A.L. Grant) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus rupicola* Coville & A.L. Grant, J. Wash. Acad. Sci. 26: 99 1936.

*Diplacus rupicola* is endemic to Inyo County, California; *D. parryi* also occurs there as well as in nearby regions of Nevada, Utah, and Arizona.

These two species are placed as sister species (100% bootstrap confidence) in the molecular analysis by Beardsley et al. (2004) and very weakly supported as sister to the rest of the genus *Diplacus* (Fig. 1). They differ in a number of striking features, as in the couplet below, but both are species of Mojave Desert habitats and both have unequal stigma lobes, 2-flowered nodes, and a base chromosome number of  $x = 8$ . Unequal stigma lobes and 2-flowered nodes occur in other species of *Diplacus* and  $x = 8$  apparently is plesiomorphic, but their association in these two species may indicate a degree of genetic coherence.

- |  |                          |
|--|--------------------------|
| 1. Annual, hypocotyls epigeous, capsules with fragile walls, promptly dehiscent, corolla lobes without a large spot at the base; seeds ca 20–30, 0.5–0.8 mm long               | <b>Diplacus parryi</b>   |
| 1. Perennial, hypocotyls hypogeous, capsules with indurate walls, dehiscent after senescence of stem, corolla lobes with a large spot at the base; seeds 3–10, 1.2–1.5 mm long | <b>Diplacus rupicola</b> |

Because of its indurate capsule walls and hypogeous hypocotyls, *Diplacus rupicola* was included by Thompson (2005) in sect. *Oenoe* (among the species treated here as sect. *Cleisanthus*), but those species have 1-flowered nodes and a base chromosome number of  $x = 9$ . *Diplacus parryi* was included in sect. *Eunamus* because of its 2-flowered nodes and fragile-walled, promptly dehiscent capsules.

Treatment here of *Diplacus rupicola* and *D. parryi* as sister species weights the molecular data. Additional sequence data, however, or further morphological study presumably might support the positioning of *D. parryi* in sect. *Eunamus* (or at least not contradict it), leaving *Erimimulus* as a monotypic section. Alternatively, unequivocal synapomorphies might be found to link the two. The hypothesis of close relationship tentatively adopted here appeals to further study. The name of the section (from Greek, *eremos*, desert, solitude) alludes to the habitat of the species and to their juxtaposed-but-isolated taxonomic position.

2. **DIPLOACUS** sect. **EUNAMUS** (Benth.) G.L. Nesom & N.S. Fraga, **comb. nov.** *Eunamus* Benth. in DC., Prodr. 10: 374. 1846. *Mimulus* § *Eunamus* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876. **LECTOTYPE** (Thompson 2005): *Eunamus tolmei* Benth. [= *Diplacus nanus* (Hook. & Arn.) G.L. Nesom & N.S. Fraga]

*Mimulus* sect. *Mimulastrum* A. Gray in Lemmon, Bot. Gaz. (Crawfordsville) 9: 141. 1884. *Eunamus* § *Mimulastrum* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885. **TYPE**: *Mimulus mohavensis* Lemmon. Gray (in Lemmon) included only *M. mohavensis* in the new section. See comments below under sect. *Pseudonoe*.

Annual, puberulent-glandular; leaf blades narrowly elliptic, lanceolate, oblanceolate or oblong-obovate; flowers 1 per node (*D. fremontii*, *D. rattanii*, *D. viscidus*) or 2 per node; corollas yellow (*D. brevipes*, *D. whitneyi*, *D. mephiticus*) or purple to light violet, bilabiate, persistent, throat not strongly developed; styles glandular-pubescent; stigma lobes subequal to unequal; capsules fragile, symmetric at base, usually promptly dehiscent along both sutures distally (if not promptly dehiscent then straight and nearly fusiform).  $x = 8$ .

(FNANM)

- 1a. **Diplacus bigelovii** (A. Gray) G.L. Nesom, **comb. nov.** *Eunamus bigelovii* A. Gray, Pacif. Railr. Rep. 4(5): 121. 1857. *Mimulus bigelovii* (A. Gray) A. Gray, Proc. Amer. Acad. Arts 11: 96. 1876.
- 1b. **Diplacus bigelovii** var. **cuspidatus** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus bigelovii* var. *cuspidatus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 279. 1924 ["1924"].  
*Mimulus spissus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 277. 1924 ["1924"]
2. **Diplacus bolanderi** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus bolanderi* A. Gray, Proc. Amer. Acad. Arts 7: 381. 1868. *Eunamus bolanderi* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885.
3. **Diplacus brevipes** (Benth.) G.L. Nesom, **comb. nov.** *Mimulus brevipes* Benth., Scroph. Ind. 28. 1835. *Eunamus brevipes* (Benth.) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885.
4. **Diplacus clivicola** (Greenm.) G.L. Nesom, **comb. nov.** *Mimulus clivicola* Greenm., Erythraea 7: 119. 1899. *Eunamus clivicola* (Greenm.) A. Heller, Muhlenbergia 1: 60. 1904.
5. **Diplacus compactus** (D.M. Thompson) G.L. Nesom, Phytoneuron 2012-47. 1. 2012. *Mimulus viscidus* var. *compactus* D.M. Thompson, Syst. Bot. Monogr. 75: 129. 2005.
6. **Diplacus constrictus** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus subsecundus* subsp. *constrictus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 287. 1925 ("1924"). *Mimulus constrictus* (A.L. Grant) Pennell, Illustr. Fl. Pacific States 3: 722. 1951. *Mimulus viscidus* subsp. *constrictus* (A.L. Grant) Munz, Aliso 4: 99. 1958.
7. **Diplacus cusickii** (Greene) G.L. Nesom, **comb. nov.** *Eunamus cusickii* Greene, Pittonia 1: 36. 1887. *Mimulus cusickii* (Greene) Rattan, Analytical Key West Coast Bot. (ed. 3) 63. 1898.
8. **Diplacus fremontii** (Benth.) G.L. Nesom, **comb. nov.** *Eunamus fremontii* Benth. in DC., Prodr. 10: 374. 1846. *Mimulus fremontii* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 96. 1876.

- Mimulus subsecundus* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 445. 1886. *Eunanus subsecundus* (A. Gray) Greene, Pittonia 1: 37. 1887.
9. **Diplacus jepsonii** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus jepsonii* A.L. Grant, Ann. Missouri Bot. Gard. 11: 306. 1925 ("1924").
10. **Diplacus johnstonii** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus johnstonii* A.L. Grant, Ann. Missouri Bot. Gard. 11: 280. 1925 ("1924").
11. **Diplacus layneae** (Greene) G.L. Nesom, **comb. nov.** *Eunanus layneae* Greene, Bull. Calif. Acad. Sci. 1: 104. 1885. *Mimulus layneae* (Greene) Jeps., Fl. W. Calif. 405. 1901.
12. **Diplacus leptaleus** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus leptaleus* A. Gray, Proc. Amer. Acad. Arts 11: 96. 1876. *Eunanus leptaleus* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 101. 1885.
13. **Diplacus mephiticus** (Greene) G.L. Nesom, **comb. nov.** *Mimulus mephiticus* Greene, Bull. Calif. Acad. Sci. 1: 9. 1884. *Eunanus mephiticus* (Greene) Greene, Bull. Calif. Acad. Sci. 1: 102. 1885.
- Mimulus coccineus* Congdon, Erythea 7: 187. 1900.
- Mimulus angustifolius* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 298. 1925 ("1924").
- Mimulus densus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 298. 1925 ("1924").
14. **Diplacus mohavensis** (Lemmon) G.L. Nesom, **comb. nov.** *Mimulus mohavensis* Lemmon, Bot. Gaz. 9: 142. 1884. *Eunanus mohavensis* (Lemmon) Greene, Bull. Calif. Acad. Sci. 1: 106. 1885.
- Diplacus mohavensis* is similar to *D. pictus* in features of corolla morphology and color patterning, and the pair sometimes has been segregated as a ditypic *Mimulus* sect. *Mimulastrum* (e.g., Thompson 2005). Molecular data, however, indicate that *D. mohavensis* arose from within sect. *Eunanus*. It is distinct from other species of the section (and similar to *D. pictus*) in its radially symmetric, salverform-rotate corollas with an abrupt tube-throat transition and vein-patterned limb. In *D. mohavensis*, the limb is purplish brown basally with red, irregularly patterned veins fading into a wide, whitish distal border, in *D. pictus*, the limb is all white and the vein patterning is more regular and not fading distally.
15. **Diplacus nanus** (Hook. & Arn.) G.L. Nesom, **comb. nov.** *Mimulus nanus* Hook. & Arn., Bot. Beechey Voy. 378. 1839. *Eunanus nanus* (Hook. & Arn.) Holz., Contr. U.S. Natl. Herb. 3: 244. 1895. *Eunanus tolimiei* Benth. in DC. Prodr. was the name used by Benth. and Greene for this sp. Gray treated it as a syn. Benth. and Green spelled it *tolimiae*, but Benth. cited the collector as Tolmie.
- In the molecular phylogeny by Beardsley et al. (2004), samples of *Diplacus nanus* are placed in three disparate positions within the cladistic topology of the section.
16. **Diplacus ovatus** (A. Gray) G.L. Nesom, Phytoneuron 2012:47. 3. 2012. *Mimulus bigelovii* A. Gray var. *ovatus* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 445. 1886. *Mimulus ovatus* (A. Gray) N.H. Holmgren, Intermount. Fl. 4: 362. 1984.
17. **Diplacus rattanii** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus rattanii* A. Gray, Proc. Amer. Acad. Arts 20: 307. 1885. *Eunanus rattanii* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885.
- Mimulus decurtatus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 288. 1925 ("1924"). *Mimulus rattanii* var. *decurtatus* (A.L. Grant) Pennell, Notul. Nat. Acad. Nat. Sci. Philadelphia 236. 1. 1951.
18. **Diplacus vandenbergensis** (D.M. Thompson) G.L. Nesom, Phytoneuron 2012:47. 2. 2012. *Mimulus fremontii* var. *vandenbergensis* D.M. Thompson, Syst. Bot. Monogr. 75: 134. 2005.
19. **Diplacus viscidus** (Congdon) G.L. Nesom, **comb. nov.** *Mimulus viscidus* Congdon, Erythea 7: 187. 1900. *Mimulus fremontii* var. *viscidus* (Congdon) Jeps., Man. Fl. Pl. Calif. 924. 1925. *Mimulus subsecundus* var. *viscidus* (Congdon) A.L. Grant, Ann. Missouri Bot. Gard. 11: 286. 1925 ("1924").
20. **Diplacus whitneyi** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus whitneyi* A. Gray, Syn. Fl. N. Amer. 2(1, Suppl.) 445. 1886.
- Eunanus bicolor* A. Gray, Proc. Amer. Acad. Arts 7: 381. 1868. *Mimulus nanus* var. *bicolor* (A. Gray) A. Gray, Bot. California 1: 564. 1876.

The status of some of these taxa, including synonyms, is discussed by Nesom (2012f).

3. **DIPLACUS** sect. **PSEUDENOE** (A.L. Grant) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* sect. *Pseudoenoe* A.L. Grant, Ann. Missouri Bot. Gard. 11: 323. 1925 ["1924"]. TYPE: *Mimulus pictus* (Curran ex Greene) A. Gray [= *Diplacus pictus*]. Gray (in Lemmon 1884) included only *M. mohavensis* in sect. *Mimulastrum* but Greene (1885) added *M. pictus* (as *Eunanus pictus*) to the section, and Gray (1886) also included both species in sect. *Mimulastrum*. With

Grant's (1924) creation of sect. *Pseudoenoe* for *M. pictus*, each species thus constituted a monotypic section in her treatment.

Annual; pedicels shorter than calyces; corollas radially symmetric, salverform, throat not strongly developed, lobes white with an intricate weblike purple- or burgundy-veined pattern; lower stigma lobe 6–8 times longer than upper; styles glandular pubescent; flowers sometimes cleistogamous.  $x = 8$ .

(FNANM)

1. ***Diplacus pictus*** (Curran ex Greene) G.L. Nesom, **comb. nov.** *Eunanus pictus* Curran ex Greene, Bull. Calif. Acad. Sci. 1: 106 1885. *Mimulus pictus* (Curran ex Greene) A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1, Suppl.) 446 1886.

On occasions *Diplacus pictus* and *D. mohavensis* have been treated together as *Mimulus* sect. *Mimulastrum* (A. Gray) Wettst. (*M. mohavensis* the type) (e.g., Wettstein 1891, Thompson 2005). Grant (1924) separated them as monotypic sections. Despite their remarkable similarity in corolla morphology and color patterning, molecular data show *D. mohavensis* to be separately derived from within sect. *Eunanus*. Argue (1980) found that *D. pictus* has microreticulate tricolpate pollen grains while those of *D. mohavensis* are perforate tricolpate.

4. **DIPLACUS** sect. **OENOE** (A. Gray) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* § *Oenoe* A. Gray in W.H. Brewer, S. Watson, and A. Gray, Bot. California (ed. 1): 563. 1876. *Eunanus* sect. *Oenoe* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 98. 1885. **LECTOTYPE** (Thompson 2005): *Mimulus tricolor* Hartweg ex Lindley [= *Diplacus tricolor*] Benth. (Pl. Hartw. 329. 1849) appears to suggest that, instead of within *Eunanus*, *Eunanus douglasii* would be better considered within Grant's genus *Oenoe*, but in 1849 the name *Oenoe* had not yet been published at any rank.

*Mimulus* sect. *Microphyton* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 170. 1947. **TYPE:** *Mimulus pygmaeus* A.L. Grant, the only species included in the protologue.

Annual, pedicels shorter than calyces; glandular-puberulent or (*D. angustatus*) villous-nonglandular; leaves narrowly lanceolate to oblanceolate; corollas yellow (*D. pygmaeus*) or bicolored to tricolored, bilabiate to subbilabiate, broadly funnellform-rotate, tube-throats narrowly cylindric, much longer than the calyx to barely longer, persistent; anthers hairy; styles glandular-pubescent; capsules indurate, often basally asymmetric, indehiscent.  $x = 9, 10$ .

(FNANM)

1. ***Diplacus angustatus*** (A. Gray) G.L. Nesom, **comb. nov.** *Eunanus coulteri* Harvey & A. Gray ex Benth. var. *angustatus* A. Gray, Proc. Amer. Acad. Arts 7: 381 1868. *Mimulus tricolor* var. *angustatus* (A. Gray) A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876. *Eunanus angustatus* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 99 1885. *Mimulus angustatus* (A. Gray) A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1, Suppl.) 443 1886.
2. ***Diplacus pulchellus*** (Drew ex Greene) G.L. Nesom, **comb. nov.** *Eunanus pulchellus* Drew ex Greene, Pittonia 2: 104 1890. *Mimulus pulchellus* (Drew ex Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 316 1925 ("1924").
3. ***Diplacus pygmaeus*** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus pygmaeus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 312 1925 ("1924").
4. ***Diplacus tricolor*** (Hartweg ex Lindl.) G.L. Nesom, **comb. nov.** *Mimulus tricolor* Hartweg ex Lindl., J. Hort. Soc. London 4: 222 1849. *Eunanus tricolor* (Hartweg ex Lindl.) Greene, Bull. Calif. Acad. Sci. 1: 99 1885.

*Eunanus coulteri* Harvey & A. Gray ex Benth., Pl. Hartw., 329 1849.

Thompson (2005, p. 29) noted that this group of species is characterized by subequal stigma lobes, linear cotyledons, hypogeous hypocotyls, and one flower per node and that they are restricted in habitat to vernal wet depressions or seepages (contrast with sect. *Cleistanthus*). Thompson (2005) included all ten species with indehiscent fruits in sect. *Oenoe* — these are divided here among sects. *Oenoe* and *Cleistanthus*. "The indehiscent fruits of sect. *Oenoe* readily open along the inner (upper) suture after fall or winter rains wet them, long after the plant has died" (p. 29).

*Diplacus pygmaeus* was segregated by Pennell as *Mimulus* sect. *Microphyton* on the basis of its highly reduced habit and the anthers of one pair smaller or lacking.

## 5. DIPLACUS sect. DIPLACUS

Perennial herbs from a woody caudex, subshrubs, or shrubs; leaf axils of main shoots often bearing tufts of narrower leaves; leaves often with revolute margins, commonly with a glutinous exudate; pedicels shorter than calyces; calyces prismatic 20–40 mm long; corolla persistent, 30–65 mm long; capsules linear-oblong, investing; styles glandular pubescent.  $x = 9$ .

(FNANM)

- 1 ***Diplacus aridus*** Abrams, Bull. Torrey Bot. Club 32: 540. 1905. *Mimulus aridus* (Abrams) A.L. Grant, Ann. Missouri Bot. Gard. 11: 336. 1925 ("1924").
- 2 ***Diplacus aurantiacus*** (Curtis) Jeps., Man. Fl. Pl. Calif. 919. 1925. *Mimulus aurantiacus* Curtis, Bot. Mag. 10: plate 354. 1796, non *M. aurantiacus* Renjifo 1884; *Diplacus glutinosus* var. *aurantiacus* (Curtis) Lindl., Paxt. Fl. Gard. 3: pl. 92. 1851.  
*Diplacus glutinosus* (J.C. Wendl.) Nutt., Ann. Nat. Hist. 1: 138. 1838. *Mimulus glutinosus* J.C. Wendl., Bot. Beob. 51. 1798.
3. ***Diplacus x australis*** (McMinn ex Munz) Tulig, Phytoneuron 2012-45: 16. 2012. *Diplacus australis* McMinn, Madroño 11: 58, 60, plate 12. 1951 (as species), nom. illeg. (without Latin diagnosis). *Mimulus aurantiacus* subsp. *australis* McMinn ex Munz, Aliso 4: 98. 1958. *Diplacus aurantiacus* subsp. *australis* (McMinn ex Munz) Beeks ex Thorne, Aliso 9: 194. 1978. [= *Diplacus longiflorus* x *D. puniceus*?]
4. ***Diplacus calycinus*** Eastw., Bot. Gaz. 41: 287. 1906. *Mimulus longiflorus* var. *calycinus* (Eastw.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 331. 1925 ("1924"). *Diplacus longiflorus* var. *calycinus* (Eastw.) Jeps., Man. Fl. Pl. Calif. 919. 1925. *Mimulus longiflorus* subsp. *calycinus* (Eastw.) Munz, Aliso 4: 99. 1958.
- 5 ***Diplacus clelandii*** (Brandegee) Greene, Erythea 4: 22. 1896. *Mimulus clelandii* Brandegee, Gard. & Forest 8: 134, plate 20. 1895.
- 6 ***Diplacus grandiflorus*** Greenland, Rev. Hort. [Paris] ser. 4: 6. 402, fig. 136. 1857 (not *Diplacus grandiflorus* Greene, 1890). *Diplacus longiflorus* var. *grandiflorus* (Greenland) Jepson, Man. Fl. Pl. Calif. 919. 1925. *Mimulus bifidus* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 168. 1947, nom. nov. (based on *D. grandiflorus* Greenland, blocked in *Mimulus* by *M. grandiflorus* Howell 1901 = *Erythranthe guttata*).  
*Diplacus glutinosus* var. *grandiflorus* Lindl. & Paxton, Paxt. Fl. Gard. 3: 96, plate 92. 1852. *Mimulus aurantiacus* var. *grandiflorus* (Lindl. & Paxton) D.M. Thompson, Monogr. Syst. Bot. 75: 158. 2005.  
*Diplacus grandiflorus* Greene, Pittonia 2: 156. 1890, nom. illeg. (not *Diplacus grandiflorus* Greenland 1857).
- 7 ***Diplacus x linearis*** (Benth.) Greene, Pittonia 2: 156. 1890 (as species). *Mimulus linearis* Benth., Scroph. Ind., 27. 1835. *Mimulus glutinosus* var. *linearis* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876. *Mimulus longiflorus* var. *linearis* (Benth.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 334. 1925 ["1924"]. *Diplacus longiflorus* var. *linearis* (Benth.) McMinn, Man. Calif. shrubs (ed. 1) 498. 1939. [= *Diplacus aurantiacus* x *D. calycinus*?]  
*Mimulus bifidus* subsp. *fasciculatus* Pennell, Proc. Acad. Nat. Ser. Philadelphia 99: 168. 1947. *Diplacus fasciculatus* (Pennell) McMinn, Madroño 11: 70. 1951.
- 8 ***Diplacus x lompoensis*** McMinn, Madroño 11: 62. 1951 (as species). *Mimulus aurantiacus* subsp. *lompoensis* (McMinn) Munz, Aliso 4: 99. 1958. [= *Diplacus aurantiacus* x *D. longiflorus*]

9. **Diplacus longiflorus** Nuttall, Ann Nat. Hist. 1: 139. 1838. *Mimulus longiflorus* (Nutt.) A.L. Grant, Gentes Herb. 1: 136. 1923.  
*Mimulus longiflorus* var. *rutilus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 333. 1925 ("1924"). *Diplacus longiflorus* var. *rutilus* (A.L. Grant) McMinn, Man. Calif. Shrubs, 498. 1939. *Diplacus rutilus* (A.L. Grant) McMinn, Madroño 11: 83. 1951.
10. **Diplacus parviflorus** Greene, Pittonia 1: 36. 1887. *Mimulus parviflorus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 344. 1925 ("1924") (not *Mimulus parviflorus* Lindley 1825). *Mimulus flemingii* Munz, nom. nov., Man. S. Calif. Bot., 477, 601. 1935. *Mimulus aurantiacus* var. *parviflorus* (Greene) D.M. Thoms., Syst. Bot. Monogr. 75: 157. 2005.
11. **Diplacus puniceus** Nutt., Ann. Nat. Hist. 1: 137. 1838. *Mimulus puniceus* (Nutt.) Steud., Nomencl. Bot. (ed. 2) 2: 150. 1841. *Diplacus glutinosus* var. *puniceus* (Nutt.) Benth. in DC., Prodr. 10: 368. 1846. *Mimulus glutinosus* var. *puniceus* (Nutt.) A. Gray, Bot. California 1: 566. 1876. *Mimulus aurantiacus* var. *puniceus* (Nutt.) D.M. Thoms., Syst. Bot. Monogr. 75: 156. 2005.
12. **Diplacus rutilus** (A.L. Grant) McMinn, Madroño 11: 83. 1951. *Mimulus longiflorus* var. *rutilus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 333. 1925 ("1924"). *Diplacus longiflorus* var. *rutilus* (A.L. Grant) McMinn, Man. Calif. Shrubs, 498. 1939.

(MEXICO)

13. **Diplacus stellatus** Kellogg, Proc. Calif. Acad. Sci. 2: 18. 1863. *Diplacus glutinosus* var. *stellatus* (Kellogg) Greene, Pittonia 2: 155. 1890. *Mimulus stellatus* (Kellogg) A.L. Grant, Ann. Missouri Bot. Gard. 11: 337. 1925 ("1924").

Taxonomy of sect. *Diplacus* is discussed in detail by McMinn (1951), Beeks (1962), Waayers (1996), Tulig (2000), Thompson (2005), and most recently by Tulig and Nesom (2012). The taxa indicated to be hybrid in origin appear to behave essentially as species.

6. **DIPLACUS** sect. **CLEISANTHUS** (J.T. Howell) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* sect. *Cleisanthus* J.T. Howell, Leaf. W. Bot. 2: 80. 1938. **TYPE:** *Mimulus cleistogamus* J.T. Howell [= *Diplacus douglasii*]. The original circumscription of the section included only *M. cleistogamus*.

Annual, puberulent-glandular to pilose-glandular; flowers 2 per node; pedicels shorter than calyces; corollas purple to violet, bilabiate to subbilabiate or nearly radial, broadly funnellform-rotate, tube-throats narrowly cylindric, much longer than the calyx to barely longer, persistent; anthers hairy; styles glandular-pubescent; stigmas unequal, the lower longer; capsules indurate, often basally asymmetric, indehiscent.  $x = 9$ .

(FNANM)

1. **Diplacus congdonii** (B.L. Rob.) G.L. Nesom, **comb. nov.** *Mimulus congdonii* B.L. Rob., Proc. Amer. Acad. Arts 26: 175. 1891. *Eumnanus congdonii* (B.L. Rob.) Greene, Erythea 1: 247. 1893.
2. **Diplacus douglasii** (Benth.) G.L. Nesom, **comb. nov.** *Eumnanus douglasii* Benth. in DC., Prodr. 10: 374. 1846. *Mimulus douglasii* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876.  
*Mimulus cleistogamus* J.T. Howell, Leaf. West Bot. 2: 79. 1938.
3. **Diplacus kelloggii** (Curran ex Greene) G.L. Nesom, **comb. nov.** *Eumnanus kelloggii* Curran ex Greene, Bull. Calif. Acad. Sci. 1: 100. 1885. *Mimulus kelloggii* (Curran ex Greene) Curran ex A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1, Suppl.): 443. 1886.
4. **Diplacus latifolius** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus latifolius* A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876.
5. **Diplacus torreyi** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus torreyi* A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876. *Eumnanus torreyi* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 104. 1885.
6. **Diplacus traskiae** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus traskiae* A.L. Grant, Field Mus. Nat. Hist., Bot. Ser. 5: 226. 1923.

Sect. *Cleisanthus* is supported (bootstrap value = 84) in the molecular analysis of Beardsley et al. (2004) as sister to sect. *Diplacus*. Thompson (2005) placed *Diplacus torreyi* in *Mimulus* sect. *Eunamus* apparently because of its promptly dehiscent capsules with fragile walls (vs. tardily dehiscent with indurate walls), but molecular data indicate that it is sister to species 1–5 (above) of sect. *Cleisanthus*. *Diplacus torreyi* also differs from the other five species in chromosome number ( $2n = 20$  in *D. torreyi* vs.  $2n = 18$  in the others). In their combination of 2-flowered nodes and unequal stigma lobes, however, the six species of sect. *Cleisanthus* are morphologically coherent.

Thompson (2005, p. 29) noted that this group of species (he did not include *Mimulus torreyi* in his discussion) is characterized by unequal stigma lobes, ovate to rounded cotyledons, epigeous hypocotyls, two flowers per node, and their variety of habitats but never including vernal wet depressions or seepages. Also as observed by Thompson, the pedicel often twists 180° after anthesis in *D. condonii* and *D. kelloggii*, inverting the developing fruit.

**XII. LEUCOCARPUS** D. Don in Sweet, Brit. Flower Gard. ser. 2, 2: pl. 124. 1831. *Mimulus* sect. *Leucocarpus* (D. Don) G.L. Nesom, Phytoneuron 2011-36: 4. 2011. **TYPE:** *Leucocarpus alatus* (Graham) Benth. [= *Leucocarpus perfoliatus*]

**Plants** shrubs or suffrutescent perennial herbs, **Vestiture:** glabrous or subglabrous, eglandular. **Stems** lignescent, strongly 4-angled to shallowly winged, erect. **Leaves** sessile (auriculate-clasping and perfoliate), thickened, not glandular-punctate, venation eucamptodromous. **Flowers** in axillary, pedunculate cymes of (1–)2–7(–14), on short, bracteate pedicels. **Fruiting pedicels** shorter to about equal to slightly longer than the calyces. **Fruiting calyces** erect, tube midveins strongly rounded-winged in the distal 2/3. **Corollas** yellow or white with a yellow throat, deciduous, limbs bilabiate. **Stamens** 4, anthers 2-celled. **Ovaries** 2-locular; **placentation** axile; **stigmas** bilamellate. **Fruits** white berries with thin skin and with most of the substance derived from the fleshy placenta, glabrous, septicidally sulcate, indehiscent. **Seed** surface reticulate. **Chromosome number** unknown. **Species** 1.

(MEXICO, CENTRAL AMERICA, SOUTH AMERICA)

**1. *Leucocarpus perfoliatus*** (Kunth) Benth. in DC., Prodr. 10: 335. 1846. *Mimulus perfoliatus* Kunth, Nov. Gen. Sp. (quarto ed.) 2: 371. 1817 [1818].

*Conoclea alata* J. Graham, Edinburgh New Philos. J. 10: 168. 1830. *Leucocarpus alatus* (J. Graham) Benth., Brit. Flower Gard. ser. 2, 2: pl. 124. 1833 [1831].

*Leucocarpus perfoliatus* ranges from Mexico (Chiapas, Guerrero, Hidalgo, Jalisco, [Michoacan?], Oaxaca, Puebla, Querétaro, San Luis Potosí, Veracruz) and Central America (Panama, Nicaragua, Honduras, Guatemala) southward to South America (Bolivia, Colombia, Ecuador, Peru, Venezuela). It occurs at elevations of 450–3100 meters. The distinct habit (erect, up to 2.5 m tall), large and thickened-succulent leaves, pedunculate cymes, large flowers, baccate fruits, and subtropical distribution of *Leucocarpus perfoliatus* are specialized within American Phrymaceae.

**XIII. ERYTHRANTHE** Spach, Hist. Nat. Veg. Phan. 9: 312. 1838 [“1840”]. *Mimulus* § *Erythranthe* (Spach) Greene, Bull. Calif. Acad. Sci. 1: 108. 1885. **TYPE:** *Erythranthe cardinalis* (Douglas ex Benth.) Spach, the only species in the protologue.

**Annual** (fibrous-rooted or taprooted) or **perennial** (rhizomatous), terrestrial or semi-aquatic. **Vestiture:** glabrous, puberulent-glandular or villous-glandular, or hirtellous to hirsute, or a combination. **Stems** herbaceous, prostrate to decumbent or erect, terete or 4-angled. **Leaves** petiolate or sessile, herbaceous, often glandular-punctate, venation basal to suprabasal acrodromous. **Flowers** apparently solitary or axillary in bracteate, corymboid or racemose groupings. **Fruiting**

pedicels usually distinctly longer than calyces. **Fruiting calyces** erect or nodding, tube midveins weakly to strongly angled or wing-angled. **Corollas** deciduous (marcescent only in *E. breweri*) and a few species of sect. *Simiola*, limbs strongly to weakly bilabiate or nearly regular. **Stamens** 4, anthers 2-celled. **Ovaries** 2-locular; **placentation** axile; **stigmas** bilamellate. **Fruits** many-seeded capsules and blunt or rounded to slightly emarginate apices, glabrous, loosely enclosed in persistent calyx, included, bilocular, loculicidally dehiscent to base along outer suture or both sutures, placentae fused in the basal half or for the whole length, remaining fused in fruit dehiscence. **Seed** surface reticulate to nearly smooth. **Chromosome numbers**  $2n = 26, 28, 30, 32, 48, 56, 60, 62, 64, 92$  ( $x = 14, 15$ ). **Species** 111.

In adapting to the new generic name, audial memories will need to adjust in some cases to feminine forms of epithets (versus masculine in *Mimulus*). *Mimetanthe* Greene is similar, as is *Eremanthe* Spach (Clusiaceae).

Three revisionary treatments of *Erythranthe* sections, published simultaneous with this conspectus, provide full and detailed synonymy for complex groups (Nesom 2012b, 2012a, 2012c).

1. **ERYTHRANTHE** sect. **ACHLYOPITHECA** N.S. Fraga & G.L. Nesom, **sect. nov.** TYPE: *Erythranthe inconspicua* (A. Gray) G.L. Nesom & N.S. Fraga

Annual, usually glabrous; basal leaves in rosette or absent, cauline sessile, blades broadly elliptic to ovate or broadly ovate; fruiting pedicels usually longer than calyces; calyx swollen in fruit; corollas usually rose to light lavender, less commonly yellowish, caducous, limbs weakly bilabiate, lobes oblong-obovate to oblong with prominently notched apices, ventral ridges yellow-lined; anthers pubescent.  $x$  unknown.

(FNANM)

1. **Erythranthe inconspicua** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus inconspicua* A. Gray, Pacif. Railr. Rep. 4: 120. 1857.
2. **Erythranthe acutidens** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus acutidens* Greene, Bull. Calif. Acad. Sci. 1: 117. 1885. *Mimulus inconspicua* var. *acutidens* (Greene) A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 450. 1886.
3. **Erythranthe grayi** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus grayi* A.L. Grant, Ann. Missouri Bot. Gard. 11: 203. 1925 ("1924").

*Mimulus acutidens* and *M. grayi* have recently been included as synonyms of *M. inconspicua* (e.g. Thompson 1993) but the three species are distinct and non-intergrading (Nesom 2012c).

2. **ERYTHRANTHE** sect. **PARADANTHA** (A.L. Grant) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* sect. *Paradanthus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"). **LECTOTYPE** (designated here): *Mimulus rubellus* A. Gray [= *Erythranthe rubella*]. Grant specified only that sect. *Paradanthus* comprised "Sp. 26–69" but observed that "*M. rubellus* is at the center of the section" and is closely allied with members of the *Mimulus palmeri* group.

Annual, stems and leaves glabrous, sessile to subsessile, sometimes clasping and fused; leaf blades linear-oblong to narrowly oblong-lanceolate or narrowly oblanceolate, entire or sometimes toothed, palmately 3-veined or sometimes pinnately veined (*E. barbata*, *E. montioides*); fruiting pedicels longer than calyces; calyces with sharp, definite angles and flat sides (except *E. montioides* and *E. discolor*); corollas pink to purplish, yellow, white, or bicolored, throats and ventral ridges



contrasting or same color, deciduous, limbs strongly to weakly bilabiate or nearly radial, lobes deeply to shallowly notched to entire.  $x = 8$ .

(FNANM)

1. **Erythranthe androsaeca** (Curran ex Greene) N.S. Fraga, **comb. nov.** *Mimulus androsaecus* Curran ex Greene, Bull. Calif. Acad. Sci. 1: 121. 1885. *Mimulus palmeri* var. *androsaecus* (Curran ex Greene) A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 451. 1886.
2. **Erythranthe barbata** (Greene) N.S. Fraga, **comb. nov.** *Mimulus barbatus* Greene, Bull. Calif. Acad. Sci. 1: 9. 1884.
3. **Erythranthe diffusa** (A.L. Grant) N.S. Fraga, **comb. nov.** *Mimulus diffusus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 254. 1925 ("1924").
4. **Erythranthe discolor** (A.L. Grant) N.S. Fraga, **comb. nov.** *Mimulus discolor* A.L. Grant, Ann. Missouri Bot. Gard. 11: 257. 1925 ("1924").
5. **Erythranthe gracilipes** (B.L. Rob.) N.S. Fraga, **comb. nov.** *Mimulus gracilipes* B.L. Rob., Proc. Amer. Acad. Arts 26: 176. 1891.
6. **Erythranthe montioides** (A. Gray) N.S. Fraga, **comb. nov.** *Mimulus montioides* A. Gray, Proc. Amer. Acad. Arts 7: 380. 1868.
7. **Erythranthe palmeri** (A. Gray) N.S. Fraga, **comb. nov.** *Mimulus palmeri* A. Gray, Proc. Amer. Acad. Arts 12: 82. 1876.
8. **Erythranthe purpurea** (A.L. Grant) N.S. Fraga, **comb. nov.** *Mimulus purpureus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 255. 1925 ("1924").
9. **Erythranthe rubella** (A. Gray) N.S. Fraga, **comb. nov.** *Mimulus rubellus* A. Gray, Rep. U.S. Mex. Bound. 2(1): 116. 1859.
10. **Erythranthe shevockii** (Heckard & Bacig.) N.S. Fraga, **comb. nov.** *Mimulus shevockii* Heckard & Bacig., Madroño 32: 271. 1986.
11. **Erythranthe suksdorfii** (A. Gray) N.S. Fraga, **comb. nov.** *Mimulus suksdorfii* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1, Suppl.): 450. 1886.

*Erythranthe rubella* is placed in sect. *Monmanthe* in the molecular phylogeny by Beardsley et al. (2004), but four samples of the species — a yellow form and a pink form, geographically separated — in a preliminary analysis by Fraga (in prep.) place it among the species of sect. *Paradantha*, closely related to *E. suksdorfii*. At least five species of sect. *Paradantha* remain to be described (Fraga 2011 and in prep.). The single author of the combinations is deliberate.

### 3. ERYTHRANTHE sect. MONANTHA G.L. Nesom & N.S. Fraga, sect. nov. TYPE: *Erythranthe primuloides* (Benth.) G.L. Nesom & N.S. Fraga

Perennial, rhizomatous, glabrous; leaves all basal or near-basal on stems with short internodes, sessile, blades oblanceolate-oblong, palmately veined, fleshy-coriaceous; fruiting pedicels erect, much longer than calyces, 1-flowered; corollas yellow, limbs weakly to strongly bilabiate, each of the three ventral lobes usually red-spotted.  $x = 9$ .

(FNANM)

1. **Erythranthe linearifolia** (A.L. Grant) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus primuloides* var. *linearifolius* A.L. Grant, Ann. Missouri Bot. Gard. 11: 246. 1925 ("1924"). *Mimulus linearifolius* (A.L. Grant) Pennell, Ill. Fl. Pacific States 3: 698. 1951. *Mimulus primuloides* subsp. *linearifolius* (A.L. Grant) Munz, Aliso 4: 99. 1958.
2. **Erythranthe primuloides** (Benth.) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus primuloides* Benth., Scroph. Ind., 29. 1835.  
*Mimulus pilosellus* Greene, Erythea 4: 22. 1896. *Mimulus primuloides* var. *pilosellus* (Greene) Smiley, Univ. Calif. Publ. Bot. 9: 332. 1921.  
*Mimulus nevadensis* Gand., Bull. Soc. Bot. France 19: 218. 1919.

4. **ERYTHRANTHE** sect. **MONIMANTHE** (Pennell) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* sect. *Monimanthé* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 167. 1947. **TYPE:** *Mimulus breweri* (Greene) Coville [= *Erythranthe breweri*]

Annual; stems and leaves glandular-puberulent; leaves sessile to subsessile, blades oblanceolate to narrowly oblanceolate; fruiting pedicels as long or longer than calyces; calyx ciliate at apex, ribs corky (a distinctive feature of this group), teeth 1–2 mm long; corollas violet to purple with darker throat and yellow ventral ridges (*M. breweri* and *M. filicaulis*) or yellow and white (*M. bicolor*), limbs strongly to weakly bilabiate (*M. bicolor*, *M. breweri*) to nearly radially symmetric (*M. filicaulis*); anthers hairy.  $x = 8$ .

(FNANM)

- 1 **Erythranthe bicolor** (Hartweg ex Benth.) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus bicolor* Hartweg ex Benth., Pl. Hartw. 328. 1849.
- 2 **Erythranthe breweri** (Greene) G.L. Nesom & N.S. Fraga, **comb. nov.** *Eunanus breweri* Greene, Bull. Calif. Acad. Sci. 1: 101. 1885. *Mimulus breweri* (Greene) Coville, Contr. U.S. Natl. Herb. 4: 171. 1893. *Mimulus rubellus* var. *breweri* (Greene) Jeps., Man. Fl. Pl. Calif., 927. 1925.
- 3 **Erythranthe filicaulis** (S. Watson) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus filicaulis* S. Watson, Proc. Amer. Acad. Arts 26: 125. 1891.  
*Mimulus biolettii* Eastw., Proc. Calif. Acad. Sci., ser. 3, 2: 290. 1902.

In the original description of sect. *Monimanthé*, which included only the type, *Mimulus breweri*, Pennell (1947, pp. 167–168) noted that it was "midway between the subgenera *Symplocus* and *Schizoplacus* of Grant; as already explained, it has the unsplit septum of the capsule of the former, but the corollas are only tardily deciduous [marcescent] as in the latter." Molecular data show the gynoseal character to be of stronger predictive value, and the relatively long pedicels also are indicative of its placement among the species of *Erythranthe*.

#### 5. **ERYTHRANTHE** sect. **ERYTHRANTHE**

Perennial or (in *E. parishii*) annual, stems and leaves glabrous to puberulent or hirsute, sometimes glandular; leaf blades oblanceolate to narrowly lanceolate, shallowly toothed, palmately veined; fruiting pedicels longer than calyces; calyces with sharp, definite angles and flat sides; corollas deciduous, large (40–50 mm long), strongly red or magenta to pink, purplish, or (in *E. parishii*) nearly white, limbs bilabiate, lobes shallowly notched to slightly retuse or entire.  $x = 8$ .

(FNANM)

- 1 **Erythranthe cardinalis** (Douglas ex Benth.) Spach, Hist. Nat. Veg. 9: 313. 1840. *Mimulus cardinalis* Douglas ex Benth., Scroph. Ind. 28. 1835.
- 2 **Erythranthe eastwoodiae** (Rydb.) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus eastwoodiae* Rydb., Bull. Torrey Bot. Club 40: 483. 1913.
- 3 **Erythranthe lewisii** (Pursh) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus lewisii* Pursh, Fl. Amer. Sept. 2: 427. 1814.  
*Mimulus lewisii* var. *tetonensis* A. Nelson, Bot. Gaz. 34: 31. 1902. *Mimulus lewisii* forma *tetonensis* (A. Nelson) J.F. Macbr. & Payson, Contr. Gray Herb. 49: 67. 1917.

Various botanists have observed a difference in corolla color between the Sierra Nevada populations in California (mostly whitish to pink) of *Erythranthe lewisii* and those of the rest of the range (mostly purplish, including var. *tetonensis*). The type, from the "head springs of the Missouri," is described and illustrated by Pursh with a "beautiful pale purple" corolla. This pattern and an appropriate nomenclature remain to be worked out and documented.

4. **Erythranthe parishii** (Greene) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus parishii* Greene, Bull. Calif. Acad. Sci. 1: 108 1885

Greene (1885) placed *Erythranthe parishii* with *E. cardinalis* and *E. lewisii* (constituting *Mimulus* sect. *Erythranthe*) but the evolutionary position of this annual, white-flowered species among the otherwise perennial, red- and purple-flowered species was first unequivocally demonstrated by Beardsley et al. (2003, 2004).

5. **Erythranthe verbenacea** (Greene) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus verbenaceus* Greene, Leaf. Bot. Observ. Crit. 2: 2 1909 *Mimulus cardinalis* var. *verbenaceus* (Greene) Kearney & Peebles, J. Wash. Acad. Sci. 29: 491 1939

(NORTH AMERICA-Mexico)

6. **Erythranthe nelsonii** (A.L. Grant) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus nelsonii* A.L. Grant, Ann. Missouri Bot. Gard. 11: 144. 1925 ("1924").
7. **Erythranthe rupestris** (Greene) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus rupestris* Greene, Leaf. Bot. Obs. Crit. 2: 3 1909

6. **ERYTHRANTHE** sect. **ALSINIMIMULUS** G.L. Nesom & N.S. Fraga, **sect. nov.** TYPE: *Erythranthe alsinoides* (Douglas ex Benth.) G.L. Nesom & N.S. Fraga

Annual, villous-hirsute to puberulent, often glandular; leaf blades palmately veined, broadly ovate to subrotund, margins shallowly serrate-dentate to denticulate; fruiting pedicels longer than calyces; calyx margins nearly truncate; corollas tiny, yellow, palate usually with a single, large red-purple spot, each of the upper lobes medially purple-striped, limbs strongly bilabiate, throats open; stamens exserted. x unknown.

(FNANM)

1. **Erythranthe alsinoides** (Douglas ex Benth.) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus alsinoides* Douglas ex Benth., Scroph. Ind., 29 1835  
*Mimulus alsinoides* var. *minus* Benth., Scroph. Ind., 29 1835.

*Erythranthe alsinoides*, according to the molecular analysis, has a sister relationship to the clade comprising sect. *Sinopitheca* and sect. *Mimulasta*, but this relationship has weak support and *E. alsinoides* is very different in morphology. Gray (1886, p. 449) described the calyx as "campanulate-oblong, hardly at all unequal-sided at maturity or ventricose, but nearly filled by the oblong capsule; the short-toothed orifice as if truncate and moderately oblique." Grant (1924, p. 234) noted that "*M. alsinoides* is most closely related to *M. pulcherrima* [placed here in sect. *Mimulasma*] with which it has often been confused. The unequal calyx-teeth, 2 of which are truncate and longer than the 3 triangular-acute upper ones, distinguish this species from any other *Mimulus* except *M. pachystylus* [here identified as *Erythranthe orizabae*, sect. *Mimulasia*]."

7. **ERYTHRANTHE** sect. **SIMIGEMMA** G.L. Nesom & N.S. Fraga, **sect. nov.** TYPE: *Erythranthe gemmipara* (W.A. Weber) G.L. Nesom & N.S. Fraga

Annual; glabrous; petioles laterally compressed and deeply saccate at the base, usually containing a lenticular propagule; fruiting pedicels slightly longer than calyces; calyx strongly angled, weakly inflated; corollas yellow, not spotted or striped, limbs weakly bilabiate, throats open. x = 8.

(FNANM)

1. **Erythranthe gemmipara** (W.A. Weber) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus gemmiparus* W.A. Weber, Madroño 21: 423 1972

Production of bulbils enclosed within a saccate petiole is unique within the genus (Moody et al. 1999). Flowers are uncommon. Seed production has been documented in the greenhouse, but seed formation has not been documented in nature. *Erythranthe gemmipara* is known only from eight populations in north-central Colorado.

**8. ERYTHRANTHE sect. MIMULOSMA** G.L. Nesom & N.S. Fraga, **sect. nov.** TYPE: *Erythranthe moschata* (Douglas ex Lindl.) G.L. Nesom & N.S. Fraga

Annual or perennial; vestiture of viscid or gland-tipped hairs, sometimes aromatic; leaves palmately or subpinnately veined (weakly suprabasal-acrodromous); fruiting pedicels longer than calyces; calyx teeth usually small and usually of equal or subequal length; corollas yellow, rarely white, commonly red-spotted in the throat, limbs strongly to weakly bilabiate or nearly regular.  $x = 8$ .

(FNANM)

- 1 **Erythranthe ampliata** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus ampliatus* A.L. Grant, Ann. Missouri Bot. Gard 11: 214. 1925 ("1924").
- 2 **Erythranthe arenaria** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus arenarius* A.L. Grant, Ann. Missouri Bot. Gard 11: 215. 1925 ("1924")  
*Mimulus multiflorus* Pennell, Proc. Acad. Nat. Sci. Philad. 99: 161. 1947.  
*Mimulus trisulcatus* Pennell, Proc. Acad. Nat. Sci. Philad. 99: 161. 1947.  
*Mimulus floribundus* var. *subulatus* A.L. Grant, Ann. Missouri Bot. Gard 11: 222. 1925 ("1924").
- 3 **Erythranthe breviflora** (Piper) G.L. Nesom, **comb. nov.** *Mimulus breviflorus* Piper, Bull. Torrey Bot. Club 28: 45. 1901.
- 4 **Erythranthe floribunda** (Douglas ex Lindl.) G.L. Nesom, **comb. nov.** *Mimulus floribundus* Douglas ex Lindl., Bot. Reg. 13: pl. 1125. 1828.  
*Mimulus pubescens* Benth. in DC., Prodr. 10: 372. 1846. Placed here tentatively in synonymy but perhaps to be recognized as a good species — see Nesom (2012b).
- 5 **Erythranthe geniculata** (Greene) G.L. Nesom, **comb. nov.** *Mimulus geniculatus* Greene, Bull. Calif. Acad. Sci. 1: 280. 1885.  
*Mimulus dudleyi* A.L. Grant, Ann. Missouri Bot. Gard 11: 235. 1925 ("1924").
- 6 **Erythranthe hymenophylla** (Meinke) G.L. Nesom, **comb. nov.** *Mimulus hymenophyllus* Meinke, Madroño 30: 147. 1983.
- 7 **Erythranthe inflatula** (Suksd.) G.L. Nesom, **comb. nov.** *Mimulus inflatus* Suksd., Werdenda 1: 38. 1927.  
*Mimulus evanescens* Meinke, Great Basin Naturalist 55: 250. 1995.
- 8 **Erythranthe inodora** (Greene) G.L. Nesom, **comb. nov.** *Mimulus inodorus* Greene, Bull. Calif. Acad. Sci. 1: 119. 1885.  
*Mimulus moschatus* var. *sessilifolius* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 447. 1886.
- 9 **Erythranthe jungermannioides** (Suksd.) G.L. Nesom, **comb. nov.** *Mimulus jungermannioides* Suksd., Deutsche Bot. Monatsschr. 18: 154. 1900.
- 10 **Erythranthe latidens** (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus inconspicuus* A. Gray var. *latidens* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1, Suppl.): 450. 1886. *Mimulus latidens* (A. Gray) Greene, Man. Bot. San Francisco, 278. 1894.
- 11 **Erythranthe moniliformis** (Greene) G.L. Nesom, **comb. nov.** *Mimulus moniliformis* Greene, Bull. Calif. Acad. Sci. 1: 10. 1884. *Mimulus moschatus* var. *moniliformis* (Greene) Munz, Aliso 4: 99. 1958.  
*Mimulus dentatus* var. *gracilis* A. Gray, Bot. Gaz. 7: 112. 1882.  
*Mimulus leibergii* A.L. Grant, Ann. Missouri Bot. Gard 11: 231, pl. 6, f. 1. 1925 ("1924").  
*Mimulus macranthus* Pennell, Proc. Acad. Philad. 99: 160. 1947.  
*Mimulus moschatus* var. *longiflorus* A. Gray, Synopt. Fl. N. Amer. (ed. 2) 2: 278. 1886; 2(1): 447. 1886.
- 12 **Erythranthe moschata** (Douglas ex Lindl.) G.L. Nesom, **comb. nov.** *Mimulus moschatus* Douglas ex Lindl., Bot. Reg. 13: plate 1118. 1828.  
*Mimulus crinitus* A.L. Grant, Ann. Missouri Bot. Gard 11: 186. 1925 ("1924") *Mimulus acutidens* Reiche, Fl. Chile 6: 63. 1911 (non *M. acutidens* Greene 1885).

13. *Erythranthe norrisii* (Heckard & Shevock) G.L. Nesom, **comb. nov.** *Mimulus norrisii* Heckard & Shevock, Madroño 32: 179 1985
14. *Erythranthe patula* (Pennell) G.L. Nesom, **comb. nov.** *Mimulus patulus* Pennell, Proc. Acad. Natl Sci. Philadelphia 99: 162 1947
15. *Erythranthe pulsiferae* (A. Gray) G.L. Nesom, **comb. nov.** *Mimulus pulsiferae* A. Gray, Proc. Amer. Acad. Arts 11: 98 1876.
16. *Erythranthe washingtoniensis* (Gand.) G.L. Nesom, **comb. nov.** *Mimulus washingtoniensis* Gand., Bull. Soc. Bot. France 66: 218 1919.

(NORTH AMERICA -Mexico)

17. *Erythranthe australatidens* G.L. Nesom, Phytoneuron 2012-41: 23 2012

(ASIA-southeastern Russia)

18. *Erythranthe stolonifera* (Novopokr.) G.L. Nesom, **comb. nov.** *Mimulus stolonifer* Novopokr., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 11: 158 1949.

Pennell (1935) noted that the Chilean *Mimulus acutidens* Reiche of 1911 (not Greene 1885) is the same species as the North American *M. moschatus*. Von Bohlen (1995b) maintained the Chilean entity as a distinct species — *M. crinitus* (incl. *M. acutidens* Reiche as a synonym) — but noted that a closer analysis of North American material of *M. moschatus* is necessary for a better judgement. Present studies (Nesom 2011b) corroborate Pennell's assessment. Von Bohlen also placed the Chilean *Mimulus bridgesii* in this relationship (sect. *Mimulosma*), especially based on similarities in calyx and pollen morphology, but that species is placed here in the otherwise Asian *Erythranthe* sect. *Sinopitheca*.

Sect. *Mimulosma* (as considered here) has been studied recently by Argue (1986) and Whittall et al. (2006). *Erythranthe latidens* is portrayed in the molecular analysis as phylogenetically basal to the whole section, and evidence suggests that *E. inflatula* is of hybrid origin between *E. latidens* and *E. breviflora*. *Erythranthe arenaria* was not included in the molecular samples of Whittall et al. — pollen and leaf morphology as well as geography place it in the Sierra Nevada clade. *Erythranthe macrantha* and *E. moniliformis* have recently been treated as conspecific with *E. moschata* but are considered here to be distinct taxa. The extra-North American species have not yet been included in a molecular study.

Two pollen types were recognized among species of the "*Mimulus moschatus* alliance" by Argue (1986). Most of the species, including *M. moschata*, have the *sexine* 2 configuration, predominantly microreticulate with supramural granules or spinules, known as *type IIc*. The pollen of *E. arenaria*, *E. gemiculata*, *E. floribunda*, and *E. moniliformis* is *type IIb*, lacking supramural granules or spinules. Argue noted that the segregation of *E. moniliformis* and *E. inodora* from *E. moschata* is supported by these observations.

A detailed study of sect. *Mimulosma* (Nesom 2012b), published simultaneously with the present manuscript, includes maps, typifications, synonymy, descriptions, and a key to the species.

9. **ERYTHRANTHE** sect. **MIMULASIA** G.L. Nesom & N.S. Fraga, **sect. nov.** **TYPE:** *Erythranthe tenella* (Bunge) G.L. Nesom & N.S. Fraga
- Mimulus* § *Teneri* Benth. in DC., Prodr. 10: 372. 1846. **LECTOTYPE** (designated here): *Mimulus tenellus* Bunge. In addition to *M. nepalensis*, *M. tenellus* and *M. dentatus*, Benth. also included *M. alsinoides*, *M. floribundus*, *M. pubescens*, *M. moschatus*, and *M. orizabae* in § *Teneri*. The last five species are placed here into three other sections, thus Benth. group was polyphyletic. The choice of type must be from among *M. nepalensis*, *M. tenellus*, and *M.*

*dentatus*, and because the position of *M. dentatus* is not unequivocal, an Asian species is chosen.

Perennial, rhizomatous; glabrous to sparsely villous or villous-hirsute, eglandular (or in *E. karakormiana*) glandular; stems quadrangular, sometimes narrowly winged; leaves petiolate, blades ovate to ovate-triangular, ovate-oblong, or suborbicular, pinnately to subpinnately veined (strongly suprabasal-acrodromous), margins coarsely serrate; fruiting pedicels usually slightly longer than calyces; corollas yellow to golden yellow, sometimes red-spotted or with a purple patch, tube-throat barely or slightly exerted from the calyx (more so in *E. dentata*), limbs strongly bilabiate, throats open; style exerted.  $x = 8$  ( $2n = 32$  reported for *E. nepalensis* by Probatova and Sokolovskaya 1986).

(Asia-Himalayas)

1. ***Erythranthe bhutanica*** (Yamazaki) G.L. Nesom, **comb. nov.** *Mimulus bhutanicus* Yamazaki, J. Jap. Bot. 68: 23. 1993.
2. ***Erythranthe bodinieri*** (Vaniot) G.L. Nesom, **comb. nov.** *Mimulus bodinieri* Vaniot, Bull. Acad. Int. Géogr. Bot. 15(185–186): 86. 1905.
3. ***Erythranthe inflata*** (Miq.) G.L. Nesom, **comb. nov.** *Torenia inflata* Miq., Ann. Mus. Bot. Lugd. Bat. 3: 192. 1867. *Mimulus inflatus* (Miq.) Nakai, Bot. Mag. (Tokyo) 33: 209. 1919.  
*Mimulus nepalensis* forma *japonicus* Miq., Prolusio Fl. Japon., 48. 1866. *Mimulus nepalensis* var. *japonicus* Miq., Mém. Biol. 9: 401. 1874.
4. ***Erythranthe karakormiana*** (Yamazaki) G.L. Nesom, **comb. nov.** *Mimulus karakormianus* Yamazaki, J. Jap. Bot. 68: 26. 1993.
5. ***Erythranthe nepalensis*** (Benth.) G.L. Nesom, **comb. nov.** *Mimulus nepalensis* Benth., Scroph. Ind., 29. 1835. *Mimulus tenellus* var. *nepalensis* (Benth.) P.C. Tsoong ex H.P. Yang, Fl. Reipubl. Popularis Sin. 67(2): 171. 1979.  
*Mimulus formosanus* Hayata, Icon. Pl. Formosan. 9: 79. 1920.  
*Mimulus assamicus* Griff., Madras J. Lit. Sci. 4: 375. 1836.
6. ***Erythranthe procerus*** (A.L. Grant) G.L. Nesom, **comb. nov.** *Mimulus nepalensis* Benth. var. *procerus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 207. 1925 ("1924"). *Mimulus tenellus* var. *procerus* (A.L. Grant) Hand.-Mazz., Symb. Sin. 7: 832. 1936.
7. ***Erythranthe szechuanensis*** (Y.Y. Pai) G.L. Nesom, **comb. nov.** *Mimulus szechuanensis* Y.Y. Pai, Contr. Inst. Bot. Natl. Acad. Peiping 2: 119. 1934.
8. ***Erythranthe tenella*** (Bunge) G.L. Nesom, **comb. nov.** *Mimulus tenellus* Bunge, Enum. Pl. China Bor., 49. 1833.
9. ***Erythranthe sinoalba*** G.L. Nesom, Phytoneuron 2012-44. 1. 2012.

Molecular data (Beardsley & Olmstead 2002; Beardsley et al. 2004) indicate that *Erythranthe bodinieri*, *E. nepalensis*, and *E. tenella* constitute a monophyletic group. *Mimulus tenellus* was treated by Hong et al. (1998) as having three varieties, *nepalensis*, *platyphyllus*, and *procerus*, in addition to var. *tenellus*. Differences between the taxa, however, are generally characteristic of those between different species, and based on the limited observations in the present study, intermediates do not occur. *Erythranthe szechuanensis*, *E. karakormiana*, and *E. bhutanensis* are similar to these in morphology and geography and are included in sect. *Mimulasia* on that basis. This whole group appears to be most closely related to the North American *Erythranthe* sect. *Mimulosma* (fide Beardsley et al. 2004). The Asian species are strongly erect and have sharply toothed leaves with acute apices; they also are distinct from sect. *Mimulosma* in vestiture but the characteristic glandularity of the American species is mirrored in *E. karakormiana* and to a lesser extent in *E. sinoalba*.

*Mimulus platyphyllus* and *M. tibeticus*, which have previously been allied with *Mimulus nepalensis*, have palmate (basal acrodromous) leaf venation and are placed here in *Erythranthe* sect. *Sinopitheca*.

(FNANM)

- 10 **Erythranthe dentata** (Nutt. ex Benth.) G.L. Nesom, **comb. nov.** *Mimulus dentatus* Nutt. ex Benth. in DC., Prodr. 10: 372. 1846.

Molecular data place *Erythranthe dentata* as sister to *E. sessilifolia* (sect. *Sinopitheca*) but the two species are different in leaf morphology. The sessile, palmately veined leaves of *E. sessilifolia* are a feature of two other Asian species (not included in the molecular analysis), which are placed here in its closer relationship. *Erythranthe dentata* may indeed prove to be most closely related to sect. *Sinopitheca* but the phylogeny needs to be re-examined in the context of additional species. At least, like *E. bridgesii* in South America and *E. orizabae* in Mexico and Central America, *E. dentata* appears to be phylogenetically isolated in its geographical area, with its closest relatives in Asia, either in sect. *Sinopitheca* or in sect. *Mimulasia*, plus one in Mexico and Central America (*E. orizabae*).

(NORTH AMERICA-Mexico and Central America)

- 11 **Erythranthe orizabae** (Benth.) G.L. Nesom, **comb. nov.** *Mimulus orizabae* Benth. in DC., Prodr. 10: 372. 1846.

*Mimulus pachystylus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 234. 1925 ("1924").

*Erythranthe orizabae* is characterized by herbaceous, prostrate stems rooting at the nodes; young stems and adaxial leaf surfaces are arachnoid-villous with long, viscid, crinkly hairs sometimes with colored cross walls; leaf blades are ovate with serrate margins, bicolored with a lighter abaxial surface, and pinnately veined (strongly suprabasal-acrodromous). It is at least superficially similar to *E. moschata*, which usually has ascending-erect stems and concolorous leaves, but the vestiture of *E. orizabae* is only of relatively coarse eglandular hairs and in this respect (as well as leaf venation) the species is more similar to sect. *Mimulasia*, which otherwise is strictly Asian. Collections of *E. orizabae* have been made from Guatemala, Chiapas, Oaxaca, Hidalgo, and Veracruz (whence the type: K, photo MO!). See Nesom (2011d) for typification and other details.

10. **ERYTHRANTHE** sect. **SINOPITHECA** G.L. Nesom & N.S. Fraga, **sect. nov.** TYPE: *Erythranthe sessilifolia* (Maxim.) G.L. Nesom & N.S. Fraga

Perennial, rhizomatous; stems, pedicels, calyces, and leaves glabrous to subglabrous; leaves sessile, blades palmately veined, margins dentate; fruiting pedicels about equal to the subtending leaves or a little longer; calyces with shallowly lobed to subtruncate margins; corollas yellow, limbs bilabiate, broadly expanded with open throats. x unknown.

(ASIA-Himalayas and Japan)

- 1 **Erythranthe bracteosa** (P.C. Tsoong) G.L. Nesom, **comb. nov.** *Mimulus bracteosus* P.C. Tsoong, Acta Phytotax. Sin. 3: 415. 1955.  
 2 **Erythranthe platyphylla** (Franch.) G.L. Nesom, **comb. nov.** *Mimulus nepalensis* var. *platyphyllus* Franch., Nouv. Arch. Mus. Hist. Nat. 10: 103. 1888. *Mimulus tenellus* var. *platyphyllus* (Franch.) P.C. Tsoong ex H.P. Yang, Fl. Reipubl. Popularis Sin. 67: 171. 1979.  
 3 **Erythranthe sessilifolia** (Maxim.) G.L. Nesom, **comb. nov.** *Mimulus sessilifolius* Maxim., Bull. Acad. Petersb. 20: 436. 1874.  
 4 **Erythranthe tibetica** (P.C. Tsoong & H.P. Yang) G.L. Nesom, **comb. nov.** *Mimulus tibeticus* P.C. Tsoong & H.P. Yang, Fl. Reipubl. Popularis Sin. 67: 166, 399 (addenda), fig. 45. 1979.

*Erythranthe bracteosa* differs from the other of these Himalayan species in its distinctly suprabasal-acrodromous venation (veins relatively few in number; Fig. 2) and linear calyx lobes, but it seems better placed here than in sect. *Mimulasia*. Venation in the Japanese *E. sessilifolia* also occasionally is weakly suprabasal.

(SOUTH AMERICA-Chile)

5. **Erythranthe bridgesii** (Benth.) G.L. Nesom, **comb. nov.** *Mimulus parviflorus* Lindl. var. *bridgesii* Benth. in DC., Prodr. 10: 371. 1846. *Mimulus bridgesii* (Benth.) Clos, Fl. Chil. [Gay] 5: 141. 1849. **TYPE.** **CHILE** The protologue has this: "In Chili australi (Bridges! n. 686), in ins. Chiloe (Darwin!)." Holotype: K?

*Erythranthe bridgesii* is characterized by its apparently annual duration, decumbent-erect to ascending-erect stems rooting at proximal nodes, glabrous and eglandular herbage, sessile, ovate to lanceolate leaves, long fruiting pedicels (16–60 mm, often longest distally), calyces with barely differentiated lobes and subtruncate margins, and yellow, red-spotted corollas (throat, palate, and lobes) with tube-throats 6–8 mm and limbs distinctly expanded but weakly bilabiate, the lobes deeply notched. Von Bohlen (1995) placed the species in the relationship of *Mimulus moschatius* (as synonym *M. crinitus* A.L. Grant) and *M. floribundus* Douglas ex Lindl., especially based on similarities in pollen morphology (or its lack of similarity to sect. *Simiolus*), but its placement within sect. *Mimulosma* is problematic.

The nearly plicate calyx angles and the sessile, semisucculent, 3–5-palmately nerved leaves of *Erythranthe bridgesii* are similar to those of *Erythranthe* sect. *Simiolus*, which has radiated in Andean South America, but pollen morphology excludes it from that group (Argue 1981). The species is tentatively placed here as a continentally disjunct member of sect. *Sinopitheca*, with which it shares glabrous vestiture, sessile (cauline) and palmately veined leaves, calyces with shallowly lobed to subtruncate margins, and broadly spreading, weakly bilabiate to nearly regular limbs. Pollen of *E. bridgesii* is tetracolpate or pentacolpate in contrast to the tricolpate pollen of its putative Asian relatives, but this was argued by Argue as a derived feature and does not negate the hypothesis of relationship offered here.

11. **ERYTHRANTHE** sect. **EXIGUA** G.L. Nesom & N.S. Fraga, **sect. nov.** **TYPE:** *Erythranthe exigua* (A. Gray) G.L. Nesom & N.S. Fraga

Annual; glandular-puberulent; leaf blades oblong-lanceolate; fruiting pedicels longer than calyces; calyces 2–3 mm long; corollas lavender, tube-throats 2–2.5 mm long, limbs bilabiate with an open throat; capsules mostly 3–3.5 mm long, longer than the calyces. x unknown.

(FNANM)

1. **Erythranthe exigua** (A. Gray) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus exiguus* A. Gray, Proc. Amer. Acad. Arts 20: 307. 1885

*Erythranthe exigua* in the molecular analysis of Beardsley et al. (2004) is placed sister to sect. *Simiola* with poor support and is on a long branch. Plants of *Mimulus exiguus* are diminutive annuals with few nodes and greatly reduced leaves, corollas, and calyces. The corollas are lavender, the calyces do not have upcurving lower lips (as in sect. *Simiola*), and the mature capsules usually are distinctly exserted from the calyces.

12. **ERYTHRANTHE** sect. **SIMIOLA** (Greene) G.L. Nesom & N.S. Fraga, **comb. nov.** *Mimulus* § *Simiolus* Greene, Bull. Calif. Acad. Sci. 1: 109. 1885. **LECTOTYPE** (designated here): *Mimulus guttatus* Fisch. ex DC. [= *Erythranthe guttata*] *Mimulus guttatus* is chosen as the type because it often is considered the "central" species of the section, often regarded as inclusive of many of the other species or regarded as directly ancestral to them. *Mimulus* § *Speciosus* Benth. in DC., Prodr. 10: 369. 1846. **LECTOTYPE** (designated here): *Mimulus luteus* L. *Mimulus luteus* is chosen here as lectotype because it is the "showiest" of the species listed by Bentham, corresponding to his epithet "speciosus."



Annual to short-lived perennial; hirtellous to hirsute or stipitate- to villous-glandular, sometimes a mixture; cauline leaf blades generally sessile and ovate (fused in *E. glaucescens*, dissected in *E. laciniata*), palmately veined; fruiting pedicels longer than calyces; fruiting calyx inflated and sagittally compressed with lower lobes characteristically turning up and folding over the lateral teeth, nearly closing the throat; corollas yellow (cream to pink or red in some Chilean species) commonly with red spots along the throat, limbs strongly bilabiate, throat compressed and occluded by swollen ventral ridges of the lower lip.  $x = 8$ .

(FNANM)

1. **Erythranthe arenicola** (Pennell) G.L. Nesom, **comb. et stat. nov.** *Mimulus guttatus* subsp. *arenicola* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 166. 1947.
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*Erythranthe glabrata* sensu lato includes various South American taxa that may prove to be discrete biological entities, e.g., *Mimulus kingii* Phil., *M. sylvaticus* Phil., *M. tener* Phil., and others). In the sense adopted here and in a study of the section (Nesom 2012a), typical *E. glabrata* (typified by a Mexican plant) is known in South America only from a population system in Colombia.

*Erythranthe lutea* var. *lutea* has yellow corollas like those of western North America, while *E. lutea* var. *variegata* has purplish corolla lobes with a white to pale-yellow throat. *Erythranthe naiandina* has a purplish-pink corollas white on the distal half of the lower three lobes. *Erythranthe cuprea* has two color forms: orange-red and yellow (Cooley et al. 2008).

A detailed study of sect. *Simola* (Nesom 2012a), published simultaneously with the present manuscript, includes maps, typifications, complete synonymy, descriptions, and a key to the species.

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## APPENDIX: HOMOTYPIC SYNONYMY AND TAXONOMIC USAGE

- I. MIMULUS** L., Sp. Pl. Sp. 2: 634. 1753; L., Gen. Pl. 283. 1754; Benth., Scroph. Indicae 29 (1835), partly (as to *M. ringens*, *M. alatus*, *M. strictus*, *M. orbicularis*, *M. gracilis*); Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 405. 2004, partly; and other authors below. **TYPE:** *Mimulus ringens* L. The genus as originally described by Linnaeus included only a single species.
- Monavia* Adans., Fam. Plant. 2: 211. 1763, nom. illeg. (superfluous name: ICN Art. 52.1). Superfluous when published, intended by Adanson as a replacement name for *Mimulus* L., which was listed as a synonym. Not *Mimulus* of Plinius, which was treated by Adanson as the name for *Rhinanthus* of Linnaeus. **TYPE:** *Mimulus ringens* L.
- Cynorrhynchium* J. Mitchell, Diss. Brevis. Princ. Bot. Zool. 29. 1769, nom. illeg. (includes type of an existing genus: ICN Art. 52.1). **TYPE:** *Mimulus ringens* L. The 1769 protologue "exactly repeated Mitchell's previous description in Acta Phys.-Med. Acad. Caes. Leop.-Francisc. Nat. Cur. 8: 207. 1748; only the genus was described, but by Linnaeus' reference in the Genera Plantarum [1754 (ed. 5), p. 283] to *Cynorrhynchium* as a synonym of *Mimulus*, Mitchell's plant was correctly identified with *M. ringens* L." (Pennell 1935, p. 112). The description by Linnaeus also incorporated much of the original by Mitchell.
- Most of Mitchell's herbarium and types are in BM-Banks, with others in G, LINN, and OXF but a collection of *Mimulus* by Mitchell apparently is not among them.
- Mimulus* § *Erecti* Benth. in DC., Prodr. 10: 369. 1846, without indication of rank, partly (as to *M. ringens*, *M. alatus*, *M. madagascariensis*, *M. gracilis*). **LECTOTYPE:** *Mimulus ringens* L. Bentham included *M. ringens*, *M. alatus*, *M. madagascariensis*, *M. gracilis*, *M. pusillus*, and *M. uvedaliae* in ser. *Erecti*. There is no clear choice for lectotype; the species selected here is one that Bentham had studied from adequate material.
- Mimulus* § *Prostrati* Benth. in DC., Prodr. 10: 373. 1846, without clear indication of rank, partly (as to *M. orbicularis*). **LECTOTYPE:** *Mimulus orbicularis* Wall. ex Benth. Bentham included *M. orbicularis*, *M. repens*, and *M. prostratus*. He noted that these comprised "Species Asiaticae vel Australasiae." This section has not been adopted subsequently and in global works these species have been consistently treated together. There is no clear choice for lectotype; the species selected here is one that Bentham had studied from adequate material.
- Mimulus* subg. *Synplacus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 126, partly.
- Mimulus* subg. *Synplacus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"). **LECTOTYPE:** *Mimulus ringens* L. Grant did not specify a type from among the four sections she included in subg. *Synplacus*. Typification of subg. *Synplacus* has not subsequently been made explicit and the subgenus has not been used to the exclusion of any sections or species among those with axile placentation. What species Grant may have had in mind as the type of subg. *Synplacus* is not clear — the choice here simply places the taxon as a synonym of *Mimulus sensu stricto*.
- Mimulus* § *Mimulus* (as "*Eumimulus*"): A. Gray, Proc. Amer. Acad. 11: 97. 1876, partly, (as to *M. ringens* and *M. alatus*); Greene, Bull. Calif. Acad. Sci. 1: 108. 1885, partly (as to *M. ringens* and *M. alatus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 276. 1886, partly, 2(1): 446. 1886, partly (idem). — *Mimulus* sect. *Mimulus* (as "*Eumimulus*"): Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876), partly; Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. gracilis*, *M. madagascariensis*); A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"), partly (to spp. listed under our sect. "*Eumimulus*" except *M. linearis*).
- Mimulus* sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. orbicularis*).

II. **THYRIDIA** W.R. Barker & Beardsley, in text above. TYPE: *Thyridia repens* (R. Br.) W.R. Barker & Beardsley.

*Mimulus* § *Prostrati* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, name without rank, partly (as to *M. repens*).

*Mimulus* sect. *Mimulus* (as “*Eumimulus*”) [auct. non Benth. & J.D. Hook.]: Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876), partly.

*Mimulus* subg. *Synplacus* auct. non A.L. Grant; Ann. Missouri Bot. Gard. 11: 126, partly, *Mimulus* sect. *Paradanthus* auct. non A.L. Grant; Ann. Missouri Bot. Gard. 11: 195. 1925 (“1924”), partly (as to *M. repens*).

*Mimulus* auct. non L. (partly, as to *M. repens*): Benth., Scroph. Indicae 29 (1835); Wettst., Nat. Pfl. IV 3b: 72 (1891); Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 405. 2004.

III. **MICROCARPAEA** R. Br., Prodr. Fl. Nov. Holland., 435. 1810; Benth. in DC., Prodr. 10: 432. 1846; Benth. & J.D. Hook., Gen. Pl. 2(2): 957 (1876); Wettst., Nat. Pfl. IV 3b: 77 (1891); Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 402. 2004. TYPE: *Microcarpaea muscosa* R. Br., nom. illeg. (= *Microcarpaea minima* (K.D. Koenig ex Retz.) Merrill), the only species in the protologue.

IV. **UVEDALIA** R. Br., Prodr. Fl. Nov. Holland., 440. 1810; Benth., Scroph. Indicae 8 (1835). TYPE: *Uvedalia linearis* R. Br., the only species in the protologue.

*Mimulus* § *Erecti* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, name without rank, partly (as to *M. uvedaliae*),

*Mimulus* subg. *Synplacus* auct. non A.L. Grant; A.L. Grant, Ann. Missouri Bot. Gard. 11: 126, partly. (as to *M. linearis*).

*Mimulus* § *Mimulus* (as “*Eumimulus*”) [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. 11: 97. 1876, partly, (as to *M. linearis*). — *Mimulus* sect. *Mimulus* (as “*Eumimulus*”) [auct. non Benth. & J.D. Hook.]: Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876), partly; Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. linearis* (R. Br.) Wettst.); A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 (“1924”), partly (as to *M. linearis* and its var. *hutea*).

*Mimulus* auct. non L., partly: authors since R. Br., Benth. (1835), and D. Don.

V. **PEPLIDIUM** Delile, Fl. Egypte [Edn. 1]: 148. 1813; [Delile, Descr. Egypte, Hist. Nat. 50, 148. 1813 (“1812”), nomen nudum]; Benth. in DC., Prodr. 10: 422. 1846; Benth. & J.D. Hook., Gen. Pl. 2(2): 957 (1876); Wettst., Nat. Pfl. IV 3b: 77. 1891; Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 402. 2004. TYPE: *Peplidium humifusum* Delile (= *Peplidium maritimum* (L.f.) Asch.), the only species in the protologue.

VI. **ELACHOLOMA** F. Muell. & Tate ex F. Muell., Vict. Naturalist 12: 14. May 1895 (“genus of Sesameae”); F. Muell. & Tate ex Tate, Trans. Roy. Soc. S. Austral. 19: 79. July 1895, nomen nudum (“Or. Pedaliaceae”); S.T. Blake, Proc. Roy. Soc. Queensl. 70: 45. 1959 (Scrophulariaceae); N.T. Burb., Dict. Austral. Pl. Gen. (Pedaliaceae or Scrophulariaceae); W.R. Barker, Fl. Cent. Austral. 329. 1981 (Scrophulariaceae); W.R. Barker, Evol. Fl. Fauna Arid Austral. 342. 1982 (Scrophulariaceae trib. Gratiolaeae subtrib. Mimulinae); Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 402. 2004 (Scrophulariaceae “Phrymaceae” trib. Microcarpaeae (as “Microcarpeae”). TYPE: *Elacholoma hornii* F. Muell. & Tate, the only species in the protologue.

*Mimulus* § *Prostrati* auct. non Benth.: Benth. in DC., Prodr. 10: 373. 1846, without clear indication of rank, partly (excl. *M. orbicularis*, *M. repens*).

*Mimulus* § *Erecti* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, name without rank, partly (as to *M. pusillus*),

*Mimulus* sect. *Mimulus* (as “*Eumimulus*”) [auct. non Benth. & J.D. Hook.]: ?Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876), partly (as to Benth. in DC. citation).

*Mimulus* subg. *Synplacus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 126, partly (as to *M. prostratus*).

*Mimulus* sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 (“1924”), partly (as to *M. prostratus* and *M. pusillus*).

*Mimulus* auct. non L. (partly, as to *M. prostratus* and/or *M. pusillus*): e.g. Benth., Fl. Austral. 4: 483. 1868; W.R. Barker, Fl. Cent. Austral. 329. 1981

VII. GLOSSOSTIGMA Wight & Arn., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 18: 355. 1836, nom. conserv.; Benth. in DC., Prodr. 10: 426. 1846; Benth. & J.D. Hook., Gen. Pl. 2(2): 958 (1876); Wettst., Nat. Pfl. IV 3b: 78. 1891; Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 403. 2004. TYPE: *Glossostigma spathulatum* Arn., nom. illeg. (*Limosella diandra* L. = *Glossostigma diandrum* (L.) Kuntze), the only species in the protologue.

*Tricholoma* Benth. in DC., Prodr. 10: 426. 1846, nom. rejic. TYPE: *T. elatnoides* Benth. = *G. elatnoides* (Benth.) Benth. ex J.D. Hook., non *Tricholoma* (Fr.) Staude, nom. cons. (Fungi: Agariceae), the sole species in the protologue.

*Mimulus* sect. *Mimulus* (as “*Eumimulus*”) [auct. non Benth. & J.D. Hook.]: Benth. & J.D. Hook., Gen. Pl. 2(2): 958 (1876), partly.

VIII. PHRYMA L., Sp. Pl. 2: 601. 1753; Schauer in DC. Prod. 11: 520. 1847 (in monotypic Phrymaceae); Benth. & J.D. Hook., Gen. Pl. 2(2): 1132 (1876) (as Verbenaceae trib. Phrymeae); Briq., Nat. Pfl. IV 3b: 361 (in monotypic Phrymaceae). 1891; Thieret, J. Arnold Arb. 53: 226. 1972; Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 402. 2004 (in Scrophulariaceae “Phrymaceae”, in note only). TYPE: *Phryma leptostachya* L., the sole species in the protologue.

*Leptostachya* Adans., Fam. 2: 201. 1763. A superfluous replacement name for *Phryma* L.

IX. HEMICHAENA Benth., Pl. Hartw., 78. 1841; Benth. & J.D. Hook., Gen. Pl. 2(2): 943 (1876); Wettst., Nat. Pfl. IV 3b: 67. 1891; Thieret, Fieldiana Bot. 34: 92. 1972; Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 404. 2004. TYPE: *Hemichaena fruticosa* Benth. (= *Mimulus fruticosus*).

*Mimulus* (subg. *Schizoplacus*) sect. *Tropanthus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 324. 1925 (“1924”). TYPE: *Mimulus treleasei* A.L. Grant (= *Mimulus levigatus*). This is the sole species in the protologue.

*Berendtia* A. Gray, Proc. Amer. Acad. Arts 7: 379. 1868 (non Goeppert 1845); Wettst., Nat. Pfl. IV 3b: 67. 1891; A.L. Grant, Ann. Missouri Bot. Gard. 11: 350. 1925 (“1924”) (in note). — *Berendtiella* Wettst. & Harms in Engl. et Prantl, I Pflanzenf., Gesamtregister zum II. bis IV. Teil: 459. 1899 [a replacement name for *Berendtia* A. Gray]. LECTOTYPE (Thieret 1972b, p. 92): *Berendtia ghesbrechtii* A. Gray (= *Mimulus rugosus*). Gray did not cite a type for his new genus, in which he included *B. ghesbrechtii*, *B. coulteri*, and *B. rugosa*.

*Leucocarpus* auct. non D. Don: Benth. in DC., Prodr. 10: 335. 1846, partly (as to *L. fruticosus*).

*Diplacus* auct. non Nutt.: Benth. in DC., Prodr. 10: 335. 1846, partly (as to *D. rugosus*). — *Mimulus* sect. *Diplacus* auct. non (Nutt.) Wettst.: Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. rugosus*).

X. MIMETANTHE Greene, Bull. Calif. Acad. Sci. 1: 181. 1886[1885]; A.L. Grant, Ann. Missouri Bot. Gard. 11: 350. 1925 (“1924”); Wettst., Nat. Pfl. IV 3b: 67. 1891 (as “*Mimelanthe*”; A.L. Grant, Ann. Missouri Bot. Gard. 11: 350. 1925 (“1924”) (in note). Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 405. 2004. TYPE: *Mimetanthe pilosa* (Benth.) Greene

*Herpestis* sect. *Mimuloides* Benth. in DC., Prodr. 10: 394. 1846. — *Mimulus* § *Mimuloides* (Benth.) Benth. & J.D. Hook., Gen. Pl. 2(2): 947. 1876; A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876; Greene, Bull. Calif. Acad. Sci. 1: 122. 1885; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2:

279. 1886; 2(1): 446. 1886. TYPE: *Herpestis pilosa* Benth. [= *Mimetanthe pilosa*] Watson (1871) noted that the species had been recognized as *Herpestis* sect. *Mimuloides* but he did not formally transfer the section to *Mimulus*.
- XI. DIPLACUS** Nutt., Ann. Nat. Hist. 1: 137. 1838; Benth. in DC., Prodr. 10: 368. 1848, partly (excl. *D. rugosus*); Greene, Bull. Calif. Acad. Sci. 1: 94. 1885. — *Mimulus* § *Diplacus* (Nutt.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876 (as to spp. in our sect. *Diplacus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 275. 1886 (as to spp. listed under our sect. *Diplacus*), 2(1): 442. 1886. — *Mimulus* sect. *Diplacus* (Nutt.) Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876); Wettst., Nat. Pfl. IV 3b: 71 (1891), partly (as to spp. listed under our sect. *Diplacus*). — *Mimulus* (subg. *Schizoplagus*) sect. *Diplacus* (Nutt.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 326. 1925 ("1924") (as to spp. in our sect. *Diplacus*). LECTOTYPE (Thompson 2005): *Diplacus glutinosus* (J.C. Wendl.) Nutt. [= *Diplacus aurantiacus*]
- Eunamus* Benth. in DC., Prodr. 10: 374. 1846; Greene, Bull. Calif. Acad. Sci. 1: 94. 1885, partly. — *Mimulus* § *Eunamus* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876 (as to spp. in our sects. *Erimimimulus*, *Eunamus*, *Oenoe*, *Cleisanthus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 273. 1886 (as to spp. listed under our sects. *Erimimimulus*, *Eunamus*, *Oenoe*, *Cleisanthus*), 2(1): 444. 1886 (as to spp. listed under our sects. *Erimimimulus*, *Eunamus*, *Cleisanthus*). — *Mimulus* sect. *Eunamus* (Benth.) Wettst.: Wettst., Nat. Pfl. IV 3b: 71 (1891) (no spp. listed). — *Mimulus* (subg. *Schizoplagus*) sect. *Eunamus* (Benth.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924") (as to spp. listed under our sects. *Erimimimulus*, *Eunamus*, *Pseudoenoe*, *Cleisanthus*). LECTOTYPE (see under *Diplacus* sect. *Eunamus*).
- Mimulus* subg. *Schizoplagus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924"). LECTOTYPE (Thompson 2005, p. 26): *Mimulus nanus* Hook. & Arn. [= *Diplacus nanus*]
- Mimulus* § *Oenoe* A. Gray in W.H. Brewer, S. Watson, and A. Gray, Bot. California (ed. 1): 563. 1876; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 443. 1886 (as to spp. listed under our sects. *Oenoe*, *Cleisanthus*). — *Eunamus* sect. *Oenoe* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to *E. angustatus*, *E. tricolor*). — *Mimulus* sect. *Oenoe* (A. Gray) Wettst., Nat. Pfl. IV 3b: 71 (1891) (no spp. listed). — *Mimulus* sect. *Oenoe* (A. Gray) A.L. Grant, Ann. Missouri Bot. Gard. 11: 309. 1925 ("1924"), partly (as to spp. listed under our sects. *Oenoe*, *Cleisanthus*). TYPIFICATION (see under sect. *Oenoe*).
- Mimulus* § *Mimulastrum* A. Gray in Lemmon, Bot. Gaz. (Crawfordsville) 9: 141. 1884; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 446. 1886, partly (as to *M. mohavensis*). — *Eunamus* § *Mimulastrum* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885 (as to *M. pictus*, *M. mohavensis*). — *Mimulus* sect. *Mimulastrum* (A. Gray) Wettst., Nat. Pfl. IV 3b: 71 (1891). — *Mimulus* sect. *Mimulastrum* (A. Gray) A.L. Grant, Ann. Missouri Bot. Gard. 11: 308. 1925 ("1924") (as to spp. listed under our sect. *Eunamus*). TYPIFICATION (see under sect. *Mimulastrum*).
- Mimulus* sect. *Pseudoenoe* A.L. Grant, Ann. Missouri Bot. Gard. 11: 323. 1925 ("1924") (as to our sect. *Pseudoenoe*). TYPIFICATION (see under sect. *Pseudoenoe*).
- Mimulus* § *Spectiosus* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, partly (as to *M. brevipes*).
- Mimulus* auct. non L.: Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 405 2004, partly.
- 1. DIPLACUS** sect. **ERIMIMIMULUS** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Diplacus parryi* (A. Gray) G.L. Nesom & N.S. Fraga
- Mimulus* (subg. *Schizoplagus*) sect. *Eunamus* auct. non (Benth.) A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"), partly (as to *M. parryi*).
- Eunamus* sect. *Eunamus* [auct. non Greene]: Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to *E. parryi*). — *Mimulus* § *Eunamus* auct. non (Benth.) A. Gray: A. Gray, Proc. Amer. Acad. 11: 97 1876, partly (as to *M. parryi*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 445. 1886, partly (as to *M. parryi*).

2. **DIPLACUS** sect. **EUNANUS** (Benth.) G.L. Nesom & N.S. Fraga, in text above. *Eunamus* Benth. in DC., Prodr. 10: 374. 1846, partly (as to *E. fremontii*, *E. tolmei*). — *Mimulus* § *Eunamus* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. leptaleus*, *M. bigelovii*, *M. namus*, *M. fremontii*, *M. bolanderi*, *M. brevipes*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 444. 1886 (as to *M. bigelovii*, *M. bolanderi*, *M. brevipes*, *E. fremontii*, *E. leptaleus*, *M. mephiticus*, *M. namus*, *M. rattanii*, *M. whitneyi*). — *Eunamus* sect. *Eunamus*: Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to *E. leptaleus*, *E. bigelovii*, *E. mephiticus*, *E. tolmei*, *E. fremontii*, *E. layneae*, *E. torreyi*, *E. rattanii*, *E. bolanderi*, *E. brevipes*). — *Mimulus* sect. *Eunamus* (Benth.) Wettst., Nat. Pfl. IV 3b: 71 (1891). — *Mimulus* (subg. *Schizoplacus*) sect. *Eunamus* (Benth.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924"), partly (as to *M. brevipes*, *M. spissus*, *M. bigelovii*, *M. johnstonii*, *M. cusickii*, *M. fremontii*, *M. subsecundus* and vars., *M. decuratus*, *M. rattanii*, *M. layneae*, *M. namus*, *M. clivicola*, *M. angustifolius*, *M. mephiticus*, *M. leptaleus*, *M. jepsonii*, *M. whitneyi*) **LECTOTYPE** (Thompson 2005): *Eunamus tolmei* Benth. [= *Diplacus namus* (Hook. & Arn.) G.L. Nesom & N.S. Fraga]

*Mimulus* § *Mimulastrum* A. Gray in Lemmon, Bot. Gaz. (Crawfordsville) 9: 141. 1884, partly (as to *M. mohavensis*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 446. 1886, partly (idem). — *Eunamus* § *Mimulastrum* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 105. 1885, partly (idem). — *Mimulus* sect. *Mimulastrum* (A. Gray) Wettst., Nat. Pfl. IV 3b: 71 (1891), partly (idem). — *Mimulus* (subg. *Schizoplacus*) sect. *Mimulastrum* (A. Gray) A.L. Grant, Ann. Missouri Bot. Gard. 11: 308. 1925 ("1924"). **TYPE**: *Mimulus mohavensis* Lemmon. Gray (in Lemmon) included only *M. mohavensis* in the new section. See comments below under sect. *Pseudoenoe*.

*Mimulus* § *Spectiosus* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, partly (as to *M. brevipes*).

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. brevipes*).

3. **DIPLACUS** sect. **PSEUDOENOE** (A.L. Grant) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* sect. *Pseudoenoe* A.L. Grant, Ann. Missouri Bot. Gard. 11: 323. 1925 ["1924"]. **TYPE**: *Mimulus pictus* (Curran ex Greene) A. Gray [= *Diplacus pictus*]. Gray (in Lemmon 1884) included only *M. mohavensis* in sect. *Mimulastrum* but Greene (1885) added *M. pictus* (as *Eunamus pictus*) to the section, and Gray (1886) also included both species in sect. *Mimulastrum*. With Grant's (1924) creation of sect. *Pseudoenoe* for *M. pictus*, each species thus constituted a monotypic section in her treatment.

*Mimulus* § *Mimulastrum* auct. non A. Gray (partly, as to *M. pictus*, see note below): Greene, Bull. Calif. Acad. Sci. 1: 105. 1885; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 446. 1886. — *Mimulus* sect. *Mimulastrum* auct. non (A. Gray) Wettst.: Wettst., Nat. Pfl. IV 3b: 71 (1891), partly (as to *M. pictus*);

4. **DIPLACUS** sect. **OENOE** (A. Gray) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* § *Oenoe* A. Gray in W.H. Brewer, S. Watson, and A. Gray, Bot. California (ed. 1): 563. 1876; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 445. 1886, partly (as to *M. angustatus*, *M. tricolor*). — [*Oenoe* A. Gray in Benth., Pl. Hartw. 329. 1849, nom. inval. (under *Eunamus douglasii*, Benth. appears to suggest that, instead of within *Eunamus*, the species would be better considered within Gray's genus *Oenoe*, but in 1849 the name *Oenoe* apparently had not yet been published at any rank)] — *Eunamus* sect. *Oenoe* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to *E. angustatus*, *E. tricolor*). — *Mimulus* sect. *Oenoe* (A. Gray) Wettst., Nat. Pfl. IV 3b: 71 (1891). — *Mimulus* (subg. *Schizoplacus*) sect. *Oenoe* (A. Gray) A.L. Grant, Ann. Missouri Bot. Gard. 11: 309. 1925 ("1924"), partly (as to *M. pygmaeus*, *M. tricolor*, *M. angustatus*). **LECTOTYPE** (Thompson 2005): *Mimulus tricolor* Hartweg ex Lindley [= *Diplacus tricolor*]

*Mimulus* sect. *Microphyton* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 170. 1947. TYPE: *Mimulus pygmaeus* A.L. Grant, the only species included in the protologue.

*Mimulus* § *Eunamus* auct. non (Benth.) A. Gray: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. tricolor* and its var. *angustatus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 274. 1886, partly (as to *M. angustatus*, *M. tricolor*).

## 5. DIPLACUS sect. DIPLACUS

*Mimulus* § *Diplacus* (Nutt.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 275. 1886, 2(1): 442. 1886. — *Diplacus* Nutt., Ann. Nat. Hist. 1: 137. 1838; Benth. in DC., Prodr. 10: 368. 1846, partly (as to *D. glutinosus*, *D. leptanthus*, *D. longiflorus*). — *Mimulus* sect. *Diplacus* (Nutt.) Wettst., Nat. Pfl. IV 3b: 71 (1891), partly (as to *M. glutinosus*, *M. puniceus*). — *Mimulus* (subg. *Schizoplacus*) sect. *Diplacus* (Nutt.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 326. 1925 ("1924") (as to *M. clevelandii*, *M. longiflorus* and vars. *calycinus* and *linearis*, *M. leptanthus*, *M. aridus*, *M. stellatus*, *M. aurantiacus*, *M. puniceus*, *M. parviflorus*). LECTOTYPE (Thompson 2005): *Diplacus glutinosus* (J.C. Wendl.) Nutt. [= *Diplacus aurantiacus*]

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. linearis*, *M. glutinosus*)

## 6. DIPLACUS sect. CLEISANTHUS (J.T. Howell) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* sect. *Cleisanthus* J.T. Howell, Leaf. W. Bot. 2: 80. 1938. TYPE: *Mimulus cleistogamus* J.T. Howell [= *Diplacus douglasii*]. The original circumscription of the section included only *M. cleistogamus*.

*Eunamus* Benth. in DC., Prodr. 10: 374. 1846, partly (as to *E. douglasii*). — *Mimulus* § *Eunamus* auct. non (Benth.) A. Gray: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. torreyi*, *M. douglasii* and *M. latifolius*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 274. 1886 (as to *M. douglasii*, *M. kelloggii*, *M. latifolius*, *M. torreyi*), 2(1): 443. 1886, partly (as to *M. torreyi*). — *Mimulus* (subg. *Schizoplacus*) sect. *Eunamus* auct. non (Benth.) A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924"), partly (as to *M. torreyi*). — *Eunamus* sect. *Eunamus* [auct. non Greene]: Greene, Bull. Calif. Acad. Sci 1: 98. 1885 (rank specified on p. 97), partly (as to *E. kelloggii*, *E. torreyi*).

*Eunamus* sect. *Oenoe* auct. non (A. Gray.) Greene: Greene, Bull. Calif. Acad. Sci 1: 98. 1885 (rank specified on p. 97), partly (as to *E. douglasii*, *E. latifolius*). — *Eunamus* § *Oenoe* auct. non A. Gray: A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 443. 1886, partly (as to *M. douglasii*, *M. kelloggii*, *M. latifolius*). — *Mimulus* (subg. *Schizoplacus*) sect. *Oenoe* auct. non (A. Gray) A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 268. 1925 ("1924"), partly (as to *M. latifolius*, *M. congonii*, *M. kelloggii*, *M. douglasii*, *M. traskiae*).

## XII. LEUCOCARPUS D. Don in Sweet, Brit. Flower Gard. ser. 2, 2: pl. 124. 1831; Benth. in DC., Prodr. 10: 335. 1846, partly (excl. *L. fruticosus*); Benth. & J.D. Hook., Gen. Pl. 2(2): 943 (1876); Wettst., Nat. Pfl. IV 3b: 63 (1891); A.L. Grant, Ann. Missouri Bot. Gard. 11: 350. 1925 ("1924") (in note); Eb. Fisch., Fam. Gen. Vasc. Pl. 7: 404. 2004. — *Mimulus* sect. *Leucocarpus* (D. Don) G.L. Nesom, Phytoneuron 2011-36: 4. 2011. TYPE: *Leucocarpus alatus* (Graham) Benth. [= *Leucocarpus perfoliatus*]

## XIII. ERYTHRANTHE Spach, Hist. Nat. Veg. Phan. 9: 312. 1838 ["1840"]. — *Mimulus* § *Erythranthe* (Spach) Greene, Bull. Calif. Acad. Sci. 1: 108. 1885. — *Mimulus* (subg. *Synplacus*) sect. *Erythranthe* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 137. 1925 ("1924") (as to ssp. in our sect. *Erythranthe*). TYPE: *Erythranthe cardinalis* (Douglas ex Benth.) Spach, the only species in the protologue.

- Mimulus* (subg. *Synplacus*) sect. *Paradanthus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"), partly (see spp. listed under our sects. except *Semigemma*, *Simiola*). TYPE (see under sect. *Paradantha*)
- Eunanus* Benth. sect. *Eunanus* [auct. non Greene]: Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to species in sect. *Monimanthus*).
- Mimulus* § *Simiolus* Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to spp. in all sects. bar *Erythranthe*, *Sinopitheca*). — *Mimulus* (subg. *Synplacus*) sect. *Simiolus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924") (as to spp. listed under our sects. *Mimulosma*, *Simiola*). TYPE (see under sect. *Simiola*)
- Mimulus* § *Speciosus* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, partly (as to spp. listed under our sects. *Monanthe*, *Erythranthe*, *Simiola*)
- Mimulus* § *Teneri* auct. non Benth.: Benth. in DC., Prodr. 10: 372. 1846, partly (as to spp. listed under our sects. *Alsinimimulus*, *Mimulosma*, *Mimulastia*).
- Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to spp. listed under our sect. *Achlyopitheca*, *Paradantha*, *Monantha*, *Erythranthe*, *Alsinimimula*, *Mimulosma*, *Mimulastia*, *Simiola*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 276. 1886, partly (as to spp. in all sections but *Mimulastia*, *Sinopitheca*, *Exigua*), 2(1): 446. 1886, partly (as to spp. in all sections but *Mimulastia*, *Sinopitheca*). — *Mimulus* sect. *Mimulus* (as "*Eumimulus*") [auct. non Benth. & J.D. Hook.]: Benth. & J.D. Hook., Gen. Pl. 2(2): 947 (1876), partly; Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to spp. listed under our sects. *Mimulosma*, *Mimulastia*, *Simiola*).
- Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to species listed under our sects. *Erythranthe*, *Simiola*, *Mimulosma*, *Alsinimimula*, *Monantha*, *Mimulastia*); Benth. in DC., Prodr. 10: 368. 1846, partly; Greene, Bull. Calif. Acad. Sci. 1: 98. 1885, partly (see under sect. *Simiola*); E. Fisch., Fam. Gen. Vasc. Pl. 7: 405. 2004, partly.

**1. ERYTHRANTHE sect. ACHLYOPITHECA** N.S. Fraga & G.L. Nesom, in text above. TYPE: *Erythranthe inconspicua* (A. Gray) G.L. Nesom & N.S. Fraga

- Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. inconspicuous*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 276. 1886, partly (as to *M. inconspicuous*), 2(1): 449. 1886, partly (as to *M. inconspicuous* and its var. *acutidens*).
- Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. inconspicua*).
- Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"), partly (as to *M. acutidens* Greene, *M. grayi*, *M. inconspicuous*, *M. acutidens*, ).

**2. ERYTHRANTHE sect. PARADANTHA** (A.L. Grant) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* (subg. *Synplacus*) sect. *Paradanthus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. palmeri*, *M. gracilipes*, *M. androsaceus*, *M. diffusus*, *M. purpureus*, *M. discolor*, *M. montioides*, *M. deflexus*, *M. suksdorfii*, *M. rubellus*, ). LECTOTYPE: *Mimulus rubellus* A. Gray [= *Erythranthe rubella*]. Grant specified only that sect. *Paradanthus* comprised "Sp. 26–69" but observed that "*M. rubellus* is at the center of the section" and is closely allied with members of the *Mimulus palmeri* group.

- Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. rubellus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 278. 1886, partly (as to *M. montioides*, *M. palmeri*, *M. rubellus*), 2(1): 450. 1886, partly (also as to *M. suksdorfii*).
- Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. montioides*, *M. rubellus*, *M. palmeri*, *M. androsaceus*).

**3. ERYTHRANTHE sect. MONANTHA** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe primuloides* (Benth.) G.L. Nesom & N.S. Fraga

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. primuloides*).

*Mimulus* § *Speciosus* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, partly (as to *M. primuloides*)

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. primuloides*): A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 278. 1886, partly (as to *M. primuloides*), 2(1): 450. 1886, partly (also as to *M. linearifolia*)

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. primuloides*).

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. primuloides*).

**4. ERYTHRANTHE sect. MONIMANTHE** (Pennell) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* sect. *Monimanthe* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 167. 1947. TYPE: *Mimulus breweri* (Greene) Coville [= *Erythranthe breweri*]

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. bicolor*, *M. biolettii*, *M. filicaultii*, *M. breweri*).

*Eunamus* sect. *Eunamus* [auct. non Greene]: Greene, Bull. Calif. Acad. Sci. 1: 98. 1885 (rank specified on p. 97), partly (as to *E. breweri*, *E. bicolor*).

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. bicolor*).

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray] (partly, as to *M. bicolor*): A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 278. 1886, 2(1): 450. 1886.

**5. ERYTHRANTHE sect. ERYTHRANTHE**

*Mimulus* § *Erythranthe* (Spach) Greene, Bull. Calif. Acad. Sci. 1: 108. 1885 (as to *M. cardinalis*, *M. lewisii*, *M. parishii*). — *Mimulus* (subg. *Synplacus*) sect. *Erythranthe* (Spach) A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924") (as to *M. cardinalis*, *M. rupestris*, *M. verbenaceus*, *M. nelsonii*). TYPE (see under genus).

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. lewisii*, ?*M. roseus*, *M. cardinalis*).

*Mimulus* § *Speciosus* auct. non Benth.: Benth. in DC., Prodr. 10: 369. 1846, partly (as to *M. cardinalis*, *M. lewisii*).

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. cardinalis*, *M. lewisii*); Gray, Syn. Fl. N. Amer. (ed. 2) 2: 276. 1886, partly (as to *M. cardinalis*, *M. lewisii*), 2(1): 446. 1886, partly (as to *M. cardinalis*).

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 126. 1925 ("1924"), partly (as to *M. eastwoodiae*, *M. lewisii*, *M. parishii*).

**6. ERYTHRANTHE sect. ALSINIMIMULUS** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe alsinoides* (Douglas ex Benth.) G.L. Nesom & N.S. Fraga

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. alsinoides*)

*Mimulus* § *Teneri* auct. non Benth.: Benth. in DC., Prodr. 10: 372. 1846, partly (as to *M. alsinoides*).

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray] (partly, as to *M. alsinoides*): A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876; A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 277. 1886, 2(1): 449. 1886.

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. alsinoides*).

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924") partly (as to *M. alsinoides*).



**8. ERYTHRANTHE sect. MIMULOSMA** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe moschata* (Douglas ex Lindl.) G.L. Nesom & N.S. Fraga

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. moschatus*, *M. floribundus*, *M. peduncularis*).

*Mimulus* § *Teneri* auct. non Benth.: Benth. in DC., Prodr. 10: 372. 1846, partly (as to *M. floribundus*, *M. pubescens*, *M. moschatus*).

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. pulsferrae*, *M. floribunda*, *M. moschatus*, *M. inodorus*, *M. montiformis*). — *Mimulus* (subg. *Synplacus*) sect. *Simiolus* auct. non (Greene) A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 145. 1925 ("1924"), partly (as to *M. crinitus*).

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. breviflorus*, *M. latidens*, *M. pulsferrae*, *M. washingtonensis*, *M. amplatus*, *M. arenarius*, *M. floribundus*, *M. jungermannioides*, *M. moschatus*, *M. leibergii*, *M. dudleyi*).

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. pulsferrae*, *M. floribundus*, *M. moschatus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 277. 1886, partly (as to *M. floribundus*, *M. moschatus* and its var. *longiflorus*, *M. pulsferrae*), 2(1): 446. 1886, partly (idem). — *Mimulus* sect. *Mimulus* (as "*Eumimulus*") [auct. non Benth. & J.D. Hook.]: Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. moschatus*).

**9. ERYTHRANTHE sect. MIMULASIA** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe tenella* (Bunge) G.L. Nesom & N.S. Fraga

*Mimulus* § *Teneri* Benth. in DC., Prodr. 10: 372. 1846, partly (as to *M. tenellus*, *M. dentatus*, *M. nepalensis*). LECTOTYPE: *Mimulus tenellus* Bunge. In addition to *M. nepalensis*, *M. tenellus* and *M. dentatus*, Benth. also included *M. alsinoides*, *M. floribundus*, *M. pubescens*, *M. moschatus*, and *M. orizabae* in § *Teneri*. The last five species are placed here into three other sections, thus Benth. group was polyphyletic. The choice of type must be from among *M. nepalensis*, *M. tenellus*, and *M. dentatus*, and because the position of *M. dentatus* is not unequivocal, an Asian species is chosen. As Benth. group names as plural adjectives are not clearly ranked (see comments above), a new, substantive name is chosen for the group.

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. dentatus*). — *Mimulus* sect. *Mimulus* (as "*Eumimulus*") [auct. non Benth. & J.D. Hook.]: Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. tenellus*, *M. nepalensis*).

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. dentatus*).

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. nepalensis*, *M. bridgesii*).

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. nepalensis*).

**10. ERYTHRANTHE sect. SINOPITHECA** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe sessilifolia* (Maxim.) G.L. Nesom & N.S. Fraga

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. sessilifolius*, *M. bridgesii*).

**11. ERYTHRANTHE sect. EXIGUA** G.L. Nesom & N.S. Fraga, in text above. TYPE: *Erythranthe exigua* (A. Gray) G.L. Nesom & N.S. Fraga

*Mimulus* (subg. *Synplacus*) sect. *Paradanthus* auct. non A.L. Grant: A.L. Grant, Ann. Missouri Bot. Gard. 11: 195. 1925 ("1924"), partly (as to *M. exiguus*).

*Mimulus* § *Simiolus* auct. non Greene: Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. exiguus*).

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 451. 1886, partly (as to *M. exiguus*).

**12. ERYTHRANTHE** sect. **SIMIOLA** (Greene) G.L. Nesom & N.S. Fraga, in text above. *Mimulus* § *Simiolus* Greene, Bull. Calif. Acad. Sci. 1: 109. 1885, partly (as to *M. tilingii*, *M. guttatus*, *M. microphyllus*, *M. nasutus*, *M. hallii*, *M. glaucescens*, *M. nudatus*, *M. laciniatus*, *M. jamesii*). — *Mimulus* (subg. *Synplacus*) sect. *Simiolus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 145. 1925 ("1924"), partly (excl. *M. crinitus*). **LECTOTYPE:** *Mimulus guttatus* Fisch. ex DC. [= *Erythranthe guttata*] *Mimulus guttatus* is chosen as the type because it often is considered the "central" species of the section, often regarded as inclusive of many of the other species or regarded as directly ancestral to them.

*Mimulus* § *Spectiosi* Benth. in DC., Prodr. 10: 369. 1846, partly (as to *M. luteus*, *M. scouleri*, *M. glabratus*, *M. pilosusculus*, *M. parviflorus*, *M. propinquus*, *M. jamesii*, *M. microphyllus*). **LECTOTYPE** (designated here): *Mimulus luteus* L. *Mimulus luteus* is chosen here as lectotype because it is the "showiest" of the species listed by Bentham, corresponding to his epithet "*speciosi*."

*Mimulus* § *Mimulus* (as "*Eumimulus*") [auct. non A. Gray]: A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876, partly (as to *M. luteus*, *M. jamesii*, *M. laciniatus*); A. Gray, Syn. Fl. N. Amer. (ed. 2) 2: 276. 1886, partly (as to *M. jamesii*, syn. *M. guttatus*, *M. laciniatus*, *M. luteus*, syn. *M. scouleri*), 2(1): 448. 1886, partly (also as to *M. glaucescens*, *M. nasutus*, *M. nudatus*). — *Mimulus* sect. *Mimulus* (as "*Eumimulus*") [auct. non Benth. & J.D. Hook.]: Wettst., Nat. Pfl. IV 3b: 72 (1891), partly (as to *M. parviflorus* Lindl., *M. luteus*).

*Mimulus* auct. non L.: Benth., Scroph. Indicae 29 (1835), partly (as to *M. luteus*, *M. lyratus*, *M. guttatus*, *M. parviflorus*, *M. glabratus*, *M. andicola*, *M. pilosusculus*).

## TAXONOMY OF *ERYTHRANTHE* SECT. *SIMIOLA* (PHRYMACEAE) IN THE USA AND MEXICO

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### ABSTRACT

*Erythranthe* sect. *Simiola* includes 31 species from North America north of Mexico (some of them also occur in Mexico): *E. arenicola*, *E. arvensis*, *E. brachystylis*, *E. caespitosa*, *E. calciphila*, *Erythranthe charlestonensis* Nesom, sp. nov., *Erythranthe chinatiensis* Nesom, sp. nov., *E. corallina*, *E. cordata*, *E. decora*, *E. geyeri*, *E. glaucescens*, *E. grandis*, *E. guttata*, *E. hallii*, *E. inamoena*, *E. laciniata*, *E. marmorata* (including *Mimulus whipplei*), *E. michiganensis*, *E. microphylla*, *E. minor*, *E. nasuta*, *E. nudata*, *E. pardalis* (including *Mimulus cupripithius*), *E. parvula*, *Erythranthe regni* Nesom, sp. nov., *E. scouleri*, *E. thermalis*, *E. tilingii*, *E. unimaculata*, and *E. utahensis*. Seven additional species, *Erythranthe brevinasuta* Nesom, sp. nov., *E. dentiloba*, *Erythranthe lagunensis* Nesom, sp. nov., *E. madrensis*, *E. pallens*, *E. pennellii*, and *Erythranthe visibilis* Nesom, sp. nov., are endemic to Mexico, while *E. glabrata* sensu stricto occurs only in Mexico, Central America, and South America. *Erythranthe geyeri*, *E. inamoena*, and *E. utahensis* have previously been treated within *M. glabratus*. The species are divided into 6 informal groups, several including subgroups. Provided here are a key to species, a description and distribution map for each species, and details of typification for all names, including synonyms. Lectotypes are designated for *Mimulus bakeri* Gandoger and ten taxa named by E.L. Greene: *M. arvensis*, *M. implexus*, *M. lucens*, *M. scouleri* var. *caespitosus*, *M. puberulus*, *Mimulus guttatus* var. *grandis*, *M. guttatus* var. *insignis*, *M. marmoratus*, *M. longulus*, and *M. subreniformis*.

**KEY WORDS:** *Mimulus* sect. *Simiolus*, *Mimulus guttatus*, *Erythranthe* sect. *Simiola*, *Erythranthe guttata*, *Erythranthe glabrata*

The species of *Erythranthe* sect. *Simiola* constitute a distinctive group in vegetative and floral morphology (Grant 1924) and in pollen morphology (Argue 1980). Molecular data indicate that the group is monophyletic (Beardsley et al. 2004) though relatively few species have been sampled. The species have previously been treated as *Mimulus* sect. *Simiolus* (see rationale for altered taxonomic concepts and nomenclature in Barker et al. 2012). The present study provides a taxonomic account of this group that differs substantially from most previous ones. The one closest in concept is that of Pennell (1951).

A number of the species of sect. *Simiola* currently serve as experimental organisms for various laboratories studying evolutionary processes (Dudash et al. 2005; Wu et al. 2008; and see further comments below), and sect. *Simiola* was the object of intensive investigation from about 1950 until the 1990s by R.K. Vickery and his students, who made hundreds of chromosome counts and interspecific and infraspecific crosses and from these data drew corresponding inferences about isolating mechanisms. Vickery, however, never provided a synthesis that correlated taxonomic concepts with data from biological studies and his only incursion into formal taxonomy involved the naming of several Mexican species. In what might be considered a summary of his studies (1978), he noted that *Mimulus guttatus* is "highly polytypic which has led many authors to propose one or another of its forms as distinct species or varieties. The segregant taxa include such distinct species as *M. glaucescens*, *M. laciniatus*, *M. nasutus*, *M. platycalyx*, and at least 20 other less clear-cut forms (Grant 1924; Pennell 1951)."

Because of ambiguous identifications and an emphasis on species concepts defined primarily by crossing relationships, many of Vickery's studies are difficult to interpret. Further, many of his evolutionary scenarios were predicated on *a priori* concepts of relationship that are not supported here.

Various botanists have studied the systematics of sect. *Simiola*, including Grant (1924), Campbell (1950), and Pennell (1935, 1947) and parts of the group have been considered in floristic treatments. Taxonomic assessments, however, have been variable in the ways they apportioned the variation and today there is little agreement on anything except for the status of a few seemingly clearly defined and mostly narrowly endemic species: *E. glaucescens*, *E. laciniata*, *E. michiganensis*, and *E. nudata*. *Erythranthe glabrata*, *E. guttata*, and *E. tiltingii* are generally recognized, but varieties and subspecies have been recognized within each and there has been no agreement on patterns of variation or infraspecific nomenclature. Many superfluous names have been proposed for variants within sect. *Simiola* and significant disagreement exists in the placement of many names even as synonyms. Beardsley et al. (2004) remarked that "the species making up this section display a high degree of environmental plasticity," which is generally true, but such observations are likely also based in part on morphological variation across more than one species.

Grant (1924) recognized 10 species of *Mimulus* sect. *Simiolus* in North America (including extra-California regions) and 8 varieties (3 in *M. tiltingii*, 5 in *M. guttatus*). Campbell (1950) recognized 4 species (excluding *M. glabratus*) and divided *M. guttatus* into 4 varieties. In the only broad treatment to recognize more narrowly defined variants, Pennell (1951) treated 20 species in sect. *Simiolus*, including *M. guttatus* with 4 varieties. For California, Munz (1959) recognized 7 species (including *M. guttatus* with 4 subspecies) and Thompson (1993) in the Jepson Manual — in the most recent overview of *Mimulus* sect. *Simiolus* — recognized only 5 species. *Mimulus guttatus* was described by Thompson (1993, p. 1043) as "Exceedingly complex; local populations may be unique but their forms intergrade over geog or elevation; variants not distinguished here." Thompson even reached across traditional boundaries to include *M. glabratus* var. *utahensis* as a synonym within his broadly interpreted *M. guttatus*.

### ***Mimulus* as a model study organism**

Evolutionary studies in *Mimulus* have emphasized isolating mechanisms and differentiation that can be documented at populational levels and small geographic scales. Evidence for the species status of *Mimulus michiganensis* (Posto & Prather 2003) and *M. cupripilius* (Macnair 1989; Macnair & Cumbes 1989) has been provided along this avenue, and other segregates, especially from within *M. guttatus* in the broad sense, have been similarly recognized, though usually more tentatively. Evidence from biological studies suggests that isolating mechanisms among these plants are readily developed in local populations, thus it seems reasonable, at least as a working assumption, that some of such formally named variants might indeed be justifiably recognized at specific rank.

Darwin's investigation (1876) of inbreeding depression and development of self-fertility in *Mimulus luteus* L. was the forerunner of monkeyflower biology. More recent studies of evolutionary processes have centered primarily on populations identified simply as *Mimulus guttatus* (usually without varietal designation or formal qualification) and as *Mimulus nasutus* (e.g., Kiang & Hamrick 1978; Sweigart & Willis 2003; Hall et al. 2006; Martin & Willis 2007, 2010; Swiegart et al. 2008; Wu et al. 2010). The California endemics *M. glaucescens*, *M. laciniatus*, and *M. nudatus*, which are generally recognized in floristic accounts, also have sometimes been included as well as a few other taxa that are often treated as synonyms in these kinds of detailed studies, e.g., *M. caespitosus*, *M. cupripilius*, *M. micranthus*, *M. platycalyx*, and *M. guttatus* var. *depauperatus* (e.g., Macnair 1989; Macnair & Cumbes 1989; Ritland 1989; Ritland & Ritland 1989; Fenster & Ritland 1992; Carr & Dudash 1996; Awadalla & Ritland 1997; Lin & Ritland 1997; Fenster & Carr 1997; Ritland & LeBlanc 2004).

The basis on which taxa in these evolutionary studies have been identified has rarely if ever been specified. Fenster and Carr (1997) referred to Munz and Keck (1968) for the identification of *Mimulus micranthus*. Ritland & Ritland (1989) provided line drawings of taxa as guides to the identity of the experimental plants (these drawings do show some diagnostic features, but that of *Mimulus nasutus* shows large, chasmogamous, long-styled flowers, which evidently are of some other species). Sweigart and Willis (2003) noted that "taxonomic classifications were verified using morphological characteristics as described by Abrams (1951)" (i.e., the treatment contributed by Pennell). Studies of "coastal perennial *M. guttatus*" by Lowry et al. (2008) apparently refer at least in large part (as established in pers. communication with Lowry) to *Erythranthe grandis* as treated in the present overview; the contrasting "inland annual *M. guttatus*" apparently is *Erythranthe microphylla*. Further, although most of these kinds of studies have indicated at least the general localities from which the plants were obtained, not a single one surveyed in the current taxonomic study has cited vouchers in documentation.

A clearer understanding of evolutionary patterns of variation in sect. *Simiola*, particularly including a knowledge of what discrete entities actually exist, surely would be valuable as these plants are being used in evolutionary studies in various labs in the USA and elsewhere (Phytosome 2011; mimulusevolution.org 2011; Mimulus Community 2011). Even with the barest taxonomic background, a group of these researchers recently received a five million dollar grant (NSF 2003) to study how new species arise by elucidating the molecular genetic basis of speciation mechanisms, concentrating on *Mimulus guttatus* and *M. nasutus* (sect. *Simiolus*) and *M. lewisii* and *M. cardinalis* (sect. *Erythranthe*).

*Mimulus* is used as a study organism because it provides "an excellent system for determining the genetic and genomic basis of adaptation and speciation," and [in *Mimulus*] "the integration of ecology and genetics with bioinformatics and genome technology offers great promise for exploring the mechanistic basis of adaptive evolution and the genetics of speciation" (Wu et al. 2008). As noted by Phytosome (2011), "*Mimulus* is uniquely suited for ecological and evolutionary studies because of its tremendous range of floral morphology (and associated pollinators), mating systems (selfing to outcrossing), growth forms (annual herbs to perennial woody shrubs), and habitat preference (desert to riparian to aquatic)."

As overstated by Phytosome, however, at least as regards sect. *Simiola*, "Unlike most plant genetic model systems, the ecology of *Mimulus* is known in great detail." Contrasting observations have been made. Meinke (1995, p. 7) referred to all populations of sect. *Simiola* in the Columbia River Basin of Oregon and Washington simply as the "*Mimulus guttatus*/*Mimulus nasutus* ecotype complex," noting that "Various ecotypes of *M. guttatus* occur throughout the entire CRB at most elevations and in virtually all mesic to aquatic habitats below high montane." Lowry and Willis (2010, p. 11) noted that "The *M. guttatus* species complex occurs across western North America as a mosaic of patchily distributed annual and perennial populations." If evolutionary patterns and species boundaries are not known, then the "ecology" surely cannot be known in a meaningful way. While it is clear, for example, that *Mimulus pardalis* and *M. nudatus* are adapted to serpentine substrates and are mostly restricted to them, hardly any generalization about the ecology of *M. guttatus* (in the broad sense of the authors noted above) can be made except that its relationship with the environment may differ greatly from one population to the next.

### Phylogenetic hypotheses for the species of sect. *Simiola*

Little is known about phylogenetic relationships among entities of *Erythranthe* sect. *Simiola*. The molecular analysis by Beardsley et al. (2004) included only a few North American species: *Mimulus dentilobus* (probably *E. parvula* as identified here), *Mimulus glabratus* (probably the same as identified here), *Mimulus glaucescens*, *Mimulus guttatus* (sensu lato, otherwise unspecified), *Mimulus micranthus* (an ambiguous identification), *Mimulus nudatus*, *Mimulus tilingii* (sensu lato), *Mimulus wienii* (presumably *E. madrensis* as identified here), and *Mimulus yecorensis* (*E. pallens* as identified here) and concluded essentially that "the relatively low genetic distances amongst taxa indicate that this clade is relatively young and that its constituent species are very closely related."

A study by Sweigart and Willis (2003) was aimed in part toward an understanding of relationships among a small group of species. The authors sampled various numbers of individuals from "39 *Mimulus guttatus* and 21 *M. nasutus* populations" as well as a few others (as identified in the study) of *M. laciniatus*, *M. nudatus*, *M. platycalyx*, and *M. tilingii*. DNA sequence variation at two nuclear loci was examined, the analysis shown in a neighbor-joining tree for each of the genes (Fig. 2, mCYCA; Fig. 3, mAP3). Nearly identical trees were shown by Sweigart et al. (2008), with the addition of tetraploid populations. A fuller phylogenetic value of these studies, however, perhaps awaits a reanalysis of the data based on accurate identification of the populations sampled. A subjective interpretation is offered here, based on the geographic locations of the sample populations, cross-references between populations included in the study, and cross-references by acronym to some of the same populations included in other studies from the Willis lab.

- \* Five populations of *Erythranthe grandis* show as a phylogenetically coherent group in Fig. 3.
- \* The middle, unresolved cluster of populations in Fig. 2 probably represents *E. microphylla*.
- \* The upper, weakly monophyletic cluster/clade ("66") in Fig. 2 probably is mostly *E. guttata* apparently intermixed with a few populations of *E. microphylla*, suggesting that introgression may be occurring (or that misidentifications are involved).
- \* Populations identified as *Erythranthe nasuta* (Figs. 2 and 3) show as strongly monophyletic. *Erythranthe laciniata* clusters with *E. nasuta* in Fig. 2 but not in Fig. 3. Populations identified as *E. nasuta* with "divergent sequences" are perhaps misidentifications of *E. microphylla*, hybrids/ introgressants between *E. nasuta* and *E. microphylla*, or some of each.
- \* The population of "*Mimulus platycalyx*" (Douglas Co., Oregon) does not cluster in Fig. 2 with any of *Erythranthe grandis*, *E. microphylla*, *E. guttata*, or *E. nasuta*. It perhaps is *E. arvensis* as identified in the current account, as Sweigart and Willis refer to *M. platycalyx* (= *Erythranthe microphylla*) as "highly selfing" (which it is not, but *Erythranthe arvensis* is).

Assumptions or hypotheses in a number of the evolutionary studies regarding progenitor-derivative relationships (particularly that one or another species is directly derived from *Mimulus guttatus*), sister relationships, or any other kind of relationship among taxa of sect. *Simiola* have been largely or completely speculative or else based on unwarranted assumptions. It has commonly been assumed (explicitly and implicitly) that *M. guttatus* is a primitive element of the section. This perhaps has been based on its relatively wide geographic range, wide variability, and perhaps its apparent perennial duration, but none of these justifies the assumption. Fishman and Willis (2008, p. 803) noted that "*M. guttatus* [is] the putative progenitor of other taxa in the complex," referring to Fenster and Ritland (1994). The cpDNA analysis of Fenster and Ritland compared populations identified as *M. laciniatus*, *M. micranthus*, *M. nasutus*, (obviously misidentified, from their illustration and description of it as herkogamous and outcrossing), and five populations of *M. guttatus* (surely misidentified at least in part, as they noted that "most populations of *M. guttatus* are annual").

In their unrooted Wagner tree, *M. guttatus* appears as terminal taxon on four separate branches and on one of the branches it is indistinguishable from *M. nasutus*. The study concluded that *M. micranthus* and *M. laciniatus* evolved from different ancestors, which probably is true, but no vouchers were cited and the small number of taxa and the misidentifications render their study hardly meaningful.

### Evolutionary processes and relationships

Many generalizations have been made about evolution within what has been presumed to be a single species. Hall and Willis (2006) documented "divergent natural selection for flowering time and local adaptation between two distinct populations of *Mimulus guttatus*." These two populations ("DUN" and "IM") are identified here with some certainty as *Erythranthe grandis* and *E. microphylla*. It is fair to say that these two species are "locally adapted" in the sense that their flowering time tracks conditions of moisture availability under which each grows, and flowering time may have been a significant factor in the evolutionary divergence of the clades of which two entities are members, but *E. grandis* and *E. microphylla* are not each other's closest relative in the hypothesis of relationships proposed below — they almost certainly arose from separate ancestors. Hall and Willis noted (p. 2474–2475) that "The extent to which local adaptation via flowering time divergence contributes to incipient ecological isolation or even speciation among *M. guttatus* populations is yet unknown, but our results suggest that it may be substantial. Under this scenario, much of the tremendous phenotypic diversity within this taxonomic species [*Mimulus guttatus*] is either directly caused or indirectly maintained by divergent, habitat dependent natural selection." At least in this instance, the distinction between *E. grandis* and *E. microphylla* appears to be indirectly maintained.

In a study using the same two populations (DUN and IM), Hall et al. (2006) posed this question: "Does life history divergence between these two populations have a genetic basis or is it completely environmentally dependent?" In the same perspective as in the Hall and Willis (2006) study, the question seems to be immediately answered by recognition that each population belongs to a different species and clade.

In the hypothesis here, the closest relatives of *Erythranthe grandis*, including *E. guttata* sensu stricto, share an essentially similar flowering regime and may occur in similar habitats. The same is true for *E. microphylla* and its closest relatives. This may help explain results that Hall et al. (2010) found surprising, i.e., that local adaptation in the same two populations of these species (DUN-*E. grandis* and IM-*E. microphylla*) is largely controlled by non-overlapping loci and that native genotypes were not uniformly locally adaptive. The perspective of still other studies using the DUN and IM populations (e.g., Arathi et al. 2002; Baker & Diggle 2011) may also be altered with the recognition that non-sister species are involved.

Other generalizations have been made about evolution within a broadly construed *Mimulus guttatus*. For example, Lowry et al. (2008) concluded that "the coast and inland populations collectively comprise distinct ecological races [of *Mimulus guttatus*]" and that "adaptations to widespread habitats can lead to the formation of reproductively isolated species." Again, what they considered ecological races are here regarded as distinct, non-sister species (*Erythranthe grandis* and *E. microphylla*).

Lowry and Willis (2010) observed that a chromosomal inversion polymorphism contributes to "adaptive divergence and reproductive isolation between annual and perennial ecotypes" of *Mimulus guttatus*. Most of the study populations were the perennial *Erythranthe grandis* and the annual *E. microphylla* (including the DUN and IM populations noted above). As interpreted in the present study, northernmost coastal perennial populations (BOB, TSG, BOB) and inland perennial populations (ANR, BOG, FAL, QNT) in the Lowry and Willis study probably were *E. guttata* (in the narrow sense). One population of *E. nasuta* (SF), an inland annual, was included. They found that

all annual populations had one inversion arrangement while all perennials had another, suggesting to them that the distribution of the two arrangements is "a function of the availability of soil moisture during summer months."

In a simpler perspective, in the Lowry and Willis study the distribution of the inversion arrangements is explained by common ancestry. Their study does not contradict a morphologically-based hypothesis that their "ecotypes" are instead better represented as four species and that among the four, the annuals *Mimulus microphyllus* and *M. nasutus* are related as a pair and the perennials *M. grandis* and *M. guttatus* are related as a pair. The data are better first interpreted outside of the assumption that all populations involved were of a single species.

Especially with the increased number of species in sect. *Simiola* recognized in the present study and different criteria for their identification, hypotheses of relationship should be reassessed based on objective criteria, and conclusions and generalizations in evolutionary studies should be reconsidered.

### Duration and environmental modification

Species of *Erythranthe* sect. *Simiola* are commonly described as "perennial" or "annual" but what is meant by those descriptors is rarely explicit. The nature of the plant base at least sometimes appears to underlie the interpretation — perennials produce rhizomes or stolons and annuals are consistently fibrous-rooted or slenderly taprooted. Or, a shift in "annual/perennial life-history" in some cases appears to nearly equate with timing of flowering (van Kleunen 2007; Lowry & Willis 2010). Morphological features and timing of flowering associated with duration are closely tied to the adoption of narrower species concepts in the present study.

*Mimulus guttatus* has been described as variable in duration.

"Plants annual and fibrous-rooted, or perennial by stout stolons, only rarely perennial from well-developed rhizomes, very variable in stature and vigor, sometimes dwarf and small-leaved, sometimes robust and nearly a meter high, and with the leaf blades up to nearly 1 dm long" Cronquist (1959, p. 344–345).

Vickery (1973) distinguished "obligate annual forms" and "obligate perennial forms" of *M. guttatus*. He also (1974) characterized the species as comprising "facultative perennial or obligate annual plants."

"While many inland populations of *M. guttatus* are annual, numerous inland perennial populations are found in areas of year-round soil moisture, such as on the edge of lakes or in rivers, hot springs, and alpine habitats (Lowry & Willis 2010, p. 4)

Others have viewed *M. guttatus* as perennial in duration.

"*Mimulus guttatus* is a riparian species which maintains its populations largely by long life span and by growing profuse stolons as propagules in nature" (Kiang 1973)

Variation in duration within *Mimulus guttatus* has been described as occurring among "ecotypes" (e.g., Meinke 1995; Lowry & Willis 2010), "ecomorphs" (Wu et al. 2007), or "ecological races" (e.g., Lowry et al. 2008; Lowry & Willis 2010), and it commonly has been attributed to phenotypic response to environmental variation, for example as described below.

"This species is the most common and the most polymorphic in the genus. It varies greatly with environmental conditions, especially in relation to the size of the stem, leaves, and



flowers ... The variety *grandis* of Greene is therefore considered to be a direct response to environment, the size of the parts being dependent on the amount of water available or on the vitality of the plant" (Grant 1924, p. 169).

Dole (1992) characterized sites themselves as "perennial" (persistently wet) or "annual" (summer drying). "Plants [of *M. guttatus*] in annual sites die each summer due to lack of moisture (although they are occasionally facultative perennials, Vickery 1959), while those in perennial sites usually persist through the summer into the fall rainy season, hence continuing growth and reproduction (J. Dole, unpublished data)." (Dole 1992, p. 651).

"In its native range where moisture is seasonally ephemeral, *M. guttatus* acts as a common annual. However, in areas where water is continuously available particularly in coastal areas, perennial individuals can be found (Dudash et al. 2005, p. 38)

Using the number of stolons per plant as a possible response to varying conditions of water availability, Murren et al. (2006) observed "significant plasticity to water availability, with generally taller plants, larger stem diameters, lower leaf perimeter to area ratios, and greater stolon and sexual production in our wet treatment" (pp. 2599-2600) They noted that stolons were produced later in the season, "consistent with wet sites in the field where plants have a longer flowering season" (p. 2600).

Van Kleunen (2007) regarded his study as documentation of adaptive evolution in life history traits, which he viewed as "plastic," connected with duration within the single species *M. guttatus*. He compared "plants of *Mimulus guttatus* originating from temporarily wet populations where the species has an enforced annual life-cycle" with "plants from permanently wet populations where the species has a perennial life-cycle" and found that the annuals invested significantly more in sexual reproduction and significantly less in vegetative reproduction, concluding that "natural watering conditions ... determine the life span of the species."

"Members of the section *Simiolus* are hydrophilic plants growing by springs, bogs, lakes and small streams. *Mimulus guttatus* will grow in such habitats either as an annual, particularly if water is seasonal, or as a perennial where conditions are suitable. In some more and places it also grows as a small unbranched annual when there is a lack of competition from better adapted species. This form flowers more quickly than conspecifics in a damper environment, and dies after producing only a few flowers" (Macnair 1989, p. 3).

Macnair, in the same publication (1989), noted that the duration of some species is genetically constrained.

*Mimulus guttatus*, *M. nasutus*, *M. cupriphilus*, *M. nudatus*, and *M. laciniatus* "are probably functional annuals in many Californian populations. However, all *M. guttatus* populations studied have been only facultatively annual since in the glasshouse they will normally survive flowering. This is also true of *M. nasutus*. Although Vickery (1964) and Kiang (1973) describe this species as an annual, I have been able to maintain it as a perennial. The other three species appear to be obligate annuals. Since the annual/perennial distinction represents a fundamental difference in plant reproductive biology, this difference between *M. cupriphilus* [annual] and *M. guttatus* [perennial] is of considerable importance" (Macnair 1989, p. 11). [Author's note: *M. cupriphilus*, *M. laciniatus*, *M. nudatus*, and *M. nasutus* always are fibrous-rooted, never producing rhizomes or stolons or rooting at basal nodes.]

Hall et al. (2006) made a similar observation about "inland annual *Mimulus guttatus*" (presumably identified as *Erythranthe microphylla* in the current study).

"Plants from these populations are facultative annuals due to seasonally dry environmental conditions, and they can be maintained indefinitely in standard greenhouse conditions" (p. 1831).

Presumably the fibrous-rooted plants maintained as "perennial" by Macnair and by Hall et al. did not develop rhizomes or stolons, thus the biological nature of this extended duration would not be homologous with that of *E. guttata*. It would be interesting to know if the potential of *E. microphylla* to be maintained "indefinitely" in the greenhouse also is found in other non-rhizomatous species of annual duration in nature.

It may be that some plants of *Erythranthe guttata* sensu stricto flower before developing rhizomes, thus appearing to be annual, but even the smallest flowering plants of this species (as regarded here) almost always have rhizomes or stolons. Further, I have not encountered a single published study that unequivocally documents the existence of variation in duration (rhizomatous vs. non-rhizomatous) among plants of any one *Mimulus* species, even though such an assumption has been made implicitly and explicitly in many studies.

In interpretation of the present study, there is a consistent distinction between species of fibrous-rooted or slenderly taprooted plants and species of rhizomatous plants. Various population systems of consistently fibrous-rooted or taprooted plants can be identified by syndromes of other morphological features and geography and are considered here as distinct evolutionary lineages, these for the most part identified as species. Potential for production of rhizomes, as in *Erythranthe guttata*, *E. grandis*, and *E. tiltingii*, for example, also appears to be genetically controlled. It is not demonstrated, however, that rhizomes are consistently correlated with an ability in these herbs to persist in nature for more than a single season. The single explicit reference to this I have encountered in literature is this: "in perennial [persistently wet] sites, clones often appear several years old (as judged upon the size of genets with many stolons)" (Dole 1992, p. 651). By inference, *E. michiganensis* apparently perennates through rhizomes as all but one of its known populations are seed-sterile.

Ritland (1989) published observations of reproduction in *Erythranthe caespitosa*, where plants characteristically produce a mass of filiform rhizomes: "In the winter of 1983-1984, plants left outside in Vancouver were subject to subfreezing temperatures for a week. Most of the plants died except for a small (1-2 mm) nucleus of the vegetative meristem at the tip of each of the several branches of the plant. These small turions fragmented from the branch very easily and in spring grew into new plants."

Some consistently fibrous-rooted non-rhizomatous species (referred to in the present study as "annual") produce decumbent stems that characteristically root at the basal nodes (e.g., *Erythranthe arvensis*, *E. cordata*, *E. mammosa*). Whether this behavior makes them potentially similar in duration to rhizomatous species is not known. In *E. glaucescens* (as discussed below), which always is fibrous-rooted, plants from at least one locality have produced leafy runners from basal cauline nodes — the latter should be investigated toward the possibility that they are genetically different from the more characteristic expression without runners. In some plants of *E. guttata*, particularly in Colorado, and in *E. decora*, plants often produce numerous long, leafy runners from basalmost nodes, apparently in addition to rhizomes — whether these runners are strictly homologous (developmentally) to rhizomes produced elsewhere in the species also is an open question.

Murren et al. (2006) used eight populations of "*Mimulus guttatus*" from Lake and Napa counties, California, to study effects of Ca/Mg ratio and water on trait expression. Through field observations, they confirmed that all of the study populations "senesced at the end of the season and

ultimately acted as annuals." Plants in some of the study populations were described as stoloniferous, apparently indicating that stolon production is not consistently correlated with perennial duration.

Production of rhizomes as a primitive feature in Phrymaceae may be a reasonable hypothesis, as some basal phyletic elements (Beardsley et al. 2004; Barker et al. 2012) are rhizomatous or otherwise perennial (e.g., *Mimulus ringens* and *Mimulus gracilis* are rhizomatous; *Leucocarpus perfoliatus* and species of *Hemichaena* are perennial but ligneous-taprooted). On the other hand, duration appears to be evolutionarily labile among (but not within) species of the family. It appears that the woodiness and perenniality of plants in *Diplacus* sect. *Diplacus* are derived from annual ancestors and such also may be the case in *Leucocarpus* and *Hemichaena*. Rhizome production in *Erythranthe* occurs in scattered species and species groups and may be derived in each of the instances. In sect. *Simiola*, rhizomes are produced in about half of the species and those species may all have arisen from annual, non-rhizomatous ancestors. In fact, it seems likely that the rhizomes of *E. tilmgii* and those of *E. guttata* are not homologous.

### Variation in flower size and morphology

Corolla size in some annual species of *Erythranthe* varies greatly. Especially notable in sect. *Simiola* are *E. arvensis*, *E. cordata*, *E. laciniata*, and *E. nasuta*. In these species flowers in the smaller range are cleistogamous but even the larger flowers, producing short but apparently chasmogamous corollas, are consistently autogamous in their arrangements of stamens and stigma.

Plants of *Erythranthe nasuta* vary greatly in stature and flowers of smaller plants are accordingly reduced in scale. Some plants produce only cleistogamous flowers, and even on a single plant short basal branches may bear numerous flowers consistently much smaller than those of the main branches. Kiang (1973, p. 229) observed that "flowers [of *E. nasuta*] are progressively reduced in size on a plant, and after ten nodes or so on the main stem, flowers often become so small [cleistogamous] as to be inconspicuous." Benedict (1993) noted that environmental stress resulted in production of cleistogamous flowers in *E. nasuta*.

Species in sect. *Simiola* that apparently produce only cleistogamous flowers are *Erythranthe brachystylis*, *E. brevinasuta*, *E. calciphila*, *E. hallii*, and *E. visibilis*. Species of the section with consistently autogamous pollination but apparently without cleistogamous corolla forms are *E. pardalis*, *E. geyeri*, and *E. inamoena*. Species with autogamous breeding and both corolla forms are *E. nasuta*, *E. laciniata*, *E. arvensis*, and *E. cordata*.

Corollas of some perennial species of *Erythranthe* sect. *Simiola* are highly variable in size. Some of the variation in *E. guttata* appears to be between populations, but plants sampled by collections often are relatively large and intrapopulational variation rarely is documented by herbarium collections. Grant (1924, p. 169) observed variation in single plants of *E. guttata*: "In several experiments, plants were marked early in the season which had corollas 3.5–4.5 cm. long; late in the summer, flowers produced on these same plants were less than half that length." Dole (1992, p. 655) observed that *E. guttata* populations "seemed to harbor relatively more genetic variation in stigma-anther distance [a common correlate of corolla length], as well as vegetative reproduction, stigma curl, corolla drop, and flowering date" than *E. microphylla* and *E. nasuta*. He speculated that high levels of self pollination resulting from anther-stigma contact in one population of *E. guttata* might reflect introgression of selfing features from *E. microphylla* at the same site. [The species identified by Dole as *E. microphylla* may have been the autogamous *E. arvensis*.]

*Erythranthe guttata* shows wide variation among populations in corolla size and anther/stigma separation, but all appear to be essentially allogamous in nature. By growing experimental populations of *E. guttata* over five generations without pollinators, Bodbyl Roels and Kelly (2011)

were able to induce pronounced changes in reduction of anther/stigma separation and in increased autogamous seed set. Similarly, in a population of *E. microphylla*, Fishman and Willis (2008) observed decreases in corolla width/length ratio and stigma-anther separation as a result of extreme pollen limitation. And at least in some populations of *E. guttata*, seed set in the absence of pollinators also may occur through delayed self pollination via corolla abscission. "Self pollination can occur as stamens, which are adnate to the corolla, drag anthers past the stigma as the corolla drops" (Dole 1992, p. 651).

In the annual *Erythranthe microphylla*, flowers as well as plants are highly variable in size. Dole's study (1992) suggests that variation in floral morphology in this species includes correlated variation in biology, the smaller flowers autogamous through stigma-anther contact prior to corolla abscission; larger flowers have separated stigmas and anthers and presumably are allogamous. In contrast, no unambiguous evidence of obligate autogamy in *E. microphylla* (in the sense of the present study) has been observed in the present study, even in the smaller corollas. In the smaller and narrower corollas, however, crowding of anthers and stigma, even when herkogamous, may lead to a higher incidence of self-pollination.

Lowry et al. (2012) studied "the genetic basis of variation in five anthocyanin phenotypes including calyx, corolla, and leaf coloration patterns that vary within and among populations of *Mimulus guttatus*," concluding that variation in calyx spotting is primarily controlled from a tandem array of three *R2R3-MYB* genes at a single major locus. They examined plants from over the whole geographic range of the species (identified without qualification in their study as *M. guttatus*; the genetic analysis included plants of *Erythranthe grandis* and *E. microphylla*) and found that the spotting was nonrandomly distributed — it is "most common in the Mediterranean regions of California [as mapped in their Fig. 3]. In the field, we have most commonly observed calyx spotting in populations that dry out quickly due to the onset of summer drought in California" (p. 90). Monthly precipitation was the climate variable most strongly correlated with the variation in spotting. An alternative explanation, however, for the non-random geographic distribution may simply be that the sampling of plants from California was biased toward *E. microphylla*, which, with its closest relatives, has a stronger tendency to produce anthocyanin pigments than *E. guttata* in the strict sense (pers. observ.). A realistic interpretation awaits accurate identifications.

### Chromosome numbers

Chromosome numbers have been reported for North American populations of sect. *Simiola* in many studies and communications (see separate listing under Literature Cited) and Vickery has made generalizations regarding evolutionary and geographic trends. The most common chromosome number in the genus *Erythranthe*,  $2n = 32$ , is indicated by the molecular-phylogenetic study by Beardsley et al. (2004) to be the primitive one. Among sections of the genus, the greatest variation in chromosome number occurs in sect. *Simiola*, and  $2n = 32$  characterizes some of those species as well. Many counts reported by Vickery et al. need to be verified because of problems in the initial identifications and inconsistent reporting of putative B-chromosomes.

No consistent attempt is made here to align each of the various chromosome counts with the publication in which it appeared. I have, however, studied vouchers for sect. *Simiola* deposited at UT by Vickery and students, and a number of these are cited where pertinent in the discussions.

A significant taxonomic insight from studies related to chromosome variation is the observation that crosses between different polyploid levels nearly always fail. Crosses between different dysploid levels produce hybrids that sometimes are sterile (Alam & Vickery 1973; Sweigart et al. 2008) but sometimes fertile. In a review of crossing relationships (Vickery 1974), one of two dysploid populations ( $n = 13$  from New Mexico) of *Erythranthe nasuta* was almost completely

genetically isolated from *M. guttatus*, but the other  $n = 13$  population (from California) was more similar to  $n = 14$  *E. nasuta* in its crossability. Identification of the seemingly aberrant population needs to be reassessed.

### South American species

Six species of *Mimulus* sect. *Simiolus* were recognized by von Bohlen (1995) as native to Chile: (1) *M. cupreus* Dombroin, (2) *M. depressus* Phil., (3) *M. glabratus* Kunth sensu lato (including *M. andicola*, *M. externus*, *M. kingii*, *M. parviflorus*, *M. pilosusculus*, *M. sylvaticus*, *M. tener*, and others), (4) *M. luteus* L. (including *M. nummularis*, *M. smithii*, *M. variegatus*, and others), (5) *M. acaulis* Phil. (= *M. minimus* von Bohlen = *M. nanus* Phil.), and (6) *M. naianandus* Watson & von Bohlen. The species occur northward from Chile along the Andes to Columbia and others are recognized (Barker et al. 2012), apparently including some represented by synonyms as treated by von Bohlen: *M. andicola* Kunth, *M. laceratus* Pennell, *M. parviflorus* Lindl., and *M. pilosusculus* Kunth. In view of the taxonomy proposed here for the North American species and the apparent ease with which isolating mechanisms are developed, it seems likely that further South American segregates will be recognized at specific rank.

Vickery divided the South American species between two subgroups (see further details below). Those of the *Mimulus glabratus* complex have a chromosome number of  $2n = 92$ , presumably derived from a hexaploid ancestor on the base of  $x = 15$ . Those of the *Mimulus luteus* complex known cytologically have a chromosome number of  $2n = 60, 62$ , and  $64$ , the variation outside of  $x = 15$  perhaps reflecting the presence of B chromosomes.

### Species concepts

The approach and process of the present taxonomic study have been similar to those made by the author in many other genera of various families. Coherent morpho-geographical patterns have been sought and, once found, it is hypothesized that population systems showing such coherence reflect real evolutionary entities. Many of the perceived taxonomic problems in sect. *Simiola* apparently have largely been because of wide variability within species rather than variation within broadly intergrading complexes and most of the species in the present account are recognized with a strong degree of confidence. Interspecific hybrids apparently do occur but do not blur taxonomic boundaries to the extent where species cannot be recognized. For example, as noted by Sweigart and Willis (2003, p. 2491), "when populations of *M. guttatus* and *M. nasutus* live in sympatry, hybrids are frequently observed (Vickery 1964, 1974; Kiang and Hamrick 1978; Ritland 1991; Fenster and Ritland 1992). Nevertheless, the two species seem to maintain their phenotypic differences even in these sympatric sites, suggesting that the effects of hybridization may be limited."

Vickery (1978, p. 425-426), noted that "The *Mimulus guttatus* complex appears to be a large assemblage of more or less well-marked semispecies ... that has characteristics of both a superspecies, i.e., a series of allopatric semispecies toward the periphery of its range, and of a syngameon, i.e., of a cluster of sympatric semispecies toward the center of its range." An emphasis on crossing relationships in defining species such that much of this group becomes essentially a single species, the "*Mimulus guttatus* complex," or a superspecies or syngameon, does not fairly represent some of the apparently discrete patterns of variation that exist among these plants.

In a study of coastal perennial and inland annual "races of *Mimulus guttatus*" (as identified in the study), Lowry et al. (2008) concluded that the two population systems comprise distinct "ecological races." They perhaps were not considered species because F2 hybrids were successfully produced in all intercrosses among F1 progeny between the two races. On the other hand, they concluded (p. 2209) that they studied "two distinct morphologically and molecular genetically diverged groups [and that] "Nearly complete prezygotic isolation through a combination of geography,

selection against immigrants, and flowering time isolation likely maintains the genetic differentiation of these coast and inland groups." "Striking morphological differences were found between coast and inland populations in the common garden greenhouse experiment" (p. 2202). "Geographically distant coastal populations (>1000 km apart from each other) are more closely related to each other than they are to adjacent inland populations" (p. 2209) and that "the coastal populations may be the result of a single evolutionary origin" (p. 2211).

In the perspective of the current account, the Lowry et al. (2008) study supports treatment of the coastal and inland population systems as distinct species. The difference in interpretation may simply reflect a difference in concept about the nature of species, but it seems more than semantic, as the authors noted (p. 2211) that "Although the coastal and inland races of *M. guttatus* appear to show approximately complete reproductive isolation, the process by which ecological races become good species remains unclear" (p. 2211) but that "adaptations to widespread habitats can lead to the formation of reproductively isolated species" (p. 2196). From the comments and photos in the publication, the two entities are identified here with strong probability as *Erythranthe grandis* (coastal perennial) and *E. microphylla* (inland annual). It is unlikely that they are in the process of evolutionary species divergence since they apparently are not each other's closest relative.

Lowry and Willis (2010) observed that a chromosomal inversion polymorphism contributes to "adaptive divergence and reproductive isolation between annual and perennial ecotypes" of *Mimulus guttatus*. Most of the study populations were the perennial *Erythranthe grandis* and the annual *E. microphylla* (including the DUN and IM populations noted above). As interpreted in the present study, northernmost coastal perennial populations (BOB, TSG, ALA) and inland perennial populations (ANR, BOG, FAL, QNT) in the Lowry and Willis study probably were *E. guttata* (in the strict sense). One population of *E. nasuta* (SF), an inland annual, was included. They found that all annual populations had one inversion arrangement while all perennials had another, suggesting to them that the distribution of the two arrangements is "a function of the availability of soil moisture during summer months."

In a simpler perspective, the distribution of the inversion arrangements is explained by common ancestry. The Lowry and Willis study does not contradict a morphologically-based hypothesis that their "ecotypes" are instead better represented as four species and that among the four, the annuals *M. microphyllus* and *M. nasutus* are related as a pair and the perennials *M. grandis* and *M. guttatus* are related as a pair. The data are better interpreted outside of the initial assumption that all populations involved were of a single species.

#### Scope of this study

The present study has been undertaken to provide a basis for the briefer account of sect. *Simiola* to be included in the taxonomic treatment of *Erythranthe* for the Flora of North America North of Mexico (Nesom & Fraga in prep.). Because geographic ranges of some of the mainly USA species include portions of Mexico and relatively few of the species appear to be endemic to Mexico, Mexican taxa and collections are reviewed here as well.

An attempt is made here to provide a complete account, with details of typification, of all the names proposed in sect. *Simiola* of North America. Online databases and digital images of type specimens (as cited here) have been helpful in this.

This account is based primarily on study of collections from ARIZ, BRIT-SMU-VDB, DAV-AHUC, MO, NMC, PH, SD, SRSC, TEX-LL, UC-JEPS, and UT. Further detailed study of additional collections, especially from Pacific Coast herbaria, surely will be able to improve interpretations and hypotheses presented here and likely even recognize additional taxa. All aspects

of the present account warrant further study in both herbarium and field. Specimens are cited only for new species, some of the previously described ones that have not been generally recognized, and to clarify aspects of variation. Collections at herbaria above can be consulted in further documentation of the concepts.

**ERYTHRANTHE** sect. **SIMIOLA** (Greene) Nesom & Fraga, *Phytoneuron* 2012-40: 00. 2012. *Mimulus* sect. *Simiolus* Greene, *Bull. Calif. Acad. Sci.* 1: 109. 1885. **LECTOTYPE** (Nesom & Fraga 2011): *Mimulus guttatus* Fischer ex DC.

**Annuals** (fibrous-rooted or taprooted) or short-lived herbaceous **perennials** (rhizomatous or producing stolons or runners), glabrous to hirtellous, hirsute, or puberulent-glandular to villous-glandular with gland-tipped hairs. **Leaf blades** generally petiolate (especially proximally) and becoming sessile distally, ovate or elliptic to rotund (perfoliate in *M. glaucescens*, lyrate-dissected to pinnatifid in *M. laciniatus*), palmately veined. **Fruiting pedicels** usually longer than subtending leaves or bracts (shorter in *E. brachystylis*). **Fruiting calyces** commonly accrescent, lobes subequal to unequal, upper usually about 1.2–2 times longer than the others, in most species the lower lobes turning upward ca. 90° and folding over the lateral teeth, closing the throat. **Corollas** yellow (cream to pink or red in some South American species), commonly red-dotted along the throat and palate, strongly to weakly bilabiate or nearly symmetric, throat and palate usually with prominent ventral ridges. **Anthers** glabrous; anther pairs didynamous or equal in length, stigma above anthers (herkogamous) or at the same level (plesiogamous). **Placentation** axile, placentae fused in the basal half or for the whole length, remaining fused in fruit dehiscence; capsule dehiscent to base along outer suture or both sutures.  $x = 8$ , presumably ( $2n = 26, 28, 30, 32, 56, 62$ , and other dysploid numbers). **Capsules** included, generally short-stipitate, surfaces often transversely rugulose-ridged.

Fruiting calyx length is measured from the calyx base to the tip of the longest lobe. Corolla tube length is measured from the corolla base to the opening (sinus bases) of the lobes. Mature capsule lengths include the stipe.

The positions of stamen pairs and stigma often can be observed from within a pressed flower if it was pressed in an appropriate plane. If not, it is relatively simple to lift the upper corolla surface (as pressed) and make the observation. Flowers with didynamous stamens and the stigma above the upper stamens (herkogamous) are assumed in the present study to be allogamous. Those with both of the stamen pairs and the stigma at essentially the same level (plesiogamous; see Nesom 2012b) are assumed to be autogamous or at least partly so.

#### An informal infrasectional classification

Vickery (1974) observed that *Mimulus* sect. *Simiolus* "consists of at least five subgroups: (1) the *M. guttatus* complex (*M. guttatus*, *M. nasutus*, *M. laciniatus*, *M. platycalyx*, *M. glaucescens*); (2) the *M. dentilobus* complex (*M. dentilobus*, *M. madrensis*, *M. pennellii*, and several others later described by Vickery as new species); (3) the *M. tilingii* complex (*M. tilingii* var. *tilingii*, *M. tilingii* var. *corallinus*, *M. implexus*, *M. caespitosus*); (4) the *M. glabratus* complex (*M. glabratus* var. *glabratus*, *M. glabratus* var. *fremontii*, *M. glabratus* var. *utahensis*, and South American taxa *M. glabratus* var. *externus*, *M. pilosusculus*, *M. andicola*); and (5) the *M. luteus* complex (South American: *M. luteus* "and its five varieties," *M. cupreus*, *M. acaulis*, *M. laceratus*).

A contrasting infrasectional classification is provided here as a guide to the North American species of *Erythranthe* sect. *Simiola* recognized in the current study, dividing them into six informal groups. The *dentilobus*, *tilingii*, and *glabratus* complexes of Vickery have analogs in the classification presented here. Placement of South American taxa is uncertain (see comments above) and they are not included.

The present arrangement is admittedly subjective, based on morphological similarity (main characters emphasized in defining the groups are listed) and personal experience with variability in each of the species. Plants are allogamous and perennial unless otherwise noted: \* = autogamous; <sup>A</sup> = annual duration.

The classification here may be helpful in further investigating relationships. It also is offered partly as a potential balance to the exuberant postulation of ancestor-derivative relationships, sister relationships, and adaptive evolution within a single species often encountered in evolutionary studies of sect. *Simiola*. Based on the arrangement hypothesized here, the following correlates appear to be reasonable.

\* The suite of characters associated with autogamous fertility is heritable (subgroups B and C of the Microphylla group) as well as evolutionarily derivative (Guttata group, Madrensis group)

\* The closest relatives of *Erythranthe nasuta* apparently are *E. brevinasuta*, *E. laciniata*, and *E. pardalis*; species next most closely related to *E. nasuta* are those of the Microphylla group

\* Annual duration is heritable (Microphylla group, subgroups A, B, and C) as well as evolutionarily derivative (Guttata group, Madrensis group)

\* Prolific rhizome production is heritable (Tilingii group and possibly the Decora group, if the two are distinct)

\* Non-closing calyces are heritable (Glabrata group), variable within a species (Madrensis group, subgroup C of the Microphylla group), and evolutionarily derivative (Tilingii group)

1. **Glabrata group** (*E. glabrata*, *E. michiganensis*, *E. geyeri*\*, *E. regni*\*<sup>A</sup>, *E. mamoenca*\*). Perennial and annual, rhizomatous or rooting at proximal nodes, fibrous-rooted in *E. regni*; calyces not closing; flowers small and autogamous or (*E. michiganensis*) larger, chasmogamous and allogamous; central USA, Mexico, and South America. x = 15.

2. **Tilingii group** (*E. tilingii*, *E. minor*, *E. caespitosa*, *E. corallina*, *E. utahensis*). Perennial; flowers large, chasmogamous and allogamous; filiform rhizomes profusely produced; mostly high elevation (except for *E. utahensis*); western USA. x = 12?, 14, 15.

3. **Decora group** (*E. decora*, *E. scouleri*). Perennial; flowers large; rhizomes numerous; leaf margins closely toothed; styles densely hairy; Washington and Oregon. x = ?

4. **Guttata group** (*E. guttata*, *E. grandis*, *E. lagunensis*\*<sup>A</sup>, *E. unimaculata*\*<sup>A</sup>, *E. thermalis*\*<sup>A</sup>, *E. arenicola*\*<sup>A</sup>). Perennial and annual; leaves oblong or elliptic to obovate, margins remotely toothed; flowers relatively large and chasmogamous and allogamous; western USA and northwestern Mexico. x = 14.

#### 5. **Microphylla group.**

Subgroup A. (*E. microphylla*\*<sup>A</sup>, *E. glaucescens*\*<sup>A</sup>, *E. marmorata*\*<sup>A</sup>, *E. nudata*\*<sup>A</sup>). Annual; flowers large or variable in size, chasmogamous and allogamous; basal and proximal cauline leaves often purplish on one or both surfaces; central California northward. x = 14.

Subgroup B. (*E. nasuta*\*<sup>A</sup>, *E. brevinasuta*\*<sup>A</sup>, *E. laciniata*\*<sup>A</sup>, *E. pardalis*\*<sup>A</sup>). Annual; flowers small (cleistogamous or slightly open, autogamous; basal and proximal cauline leaves often purplish (*E. nasuta*, *E. laciniata*); flowers often produced at all nodes, proximal to distal; Sierra Nevada of USA



(*E. laciniata*, *E. pardalis*) and broader (*E. nasuta*).  $x = 14$ . Perhaps arbitrarily separated from subgroup C.

Subgroup C. (*E. arvensis*\*<sup>A</sup>, *E. brachystylis*\*<sup>A</sup>, *E. charlestonensis*\*<sup>A</sup>, *E. cordata*\*<sup>A</sup>). Annual, often rooting at lower nodes; flowers often cleistogamous, all autogamous, produced from distal nodes; western USA.  $x = 14, 15$ .

Subgroup D. (*E. hallii*\*<sup>A</sup>). Annual; flowers small, cleistogamous, produced from distal nodes; North-central Colorado.  $x = 16$ .

## 6. Madrensis group.

Subgroup A. (*E. madrensis*, *E. pallens*, *E. calctiphila*\*<sup>A</sup>, *E. pennellii*, *E. visibilis*\*<sup>A</sup>). Perennial or annual; calyces 5-lobed or mostly 3-lobed; flowers small (allogamous or autogamous); western Mexico into southwestern USA.  $x = 16$ .

Subgroup B. (*E. chinatiensis*\*, *E. dentiloba*, *E. parvula*\*). Perennial, mat-forming; calyces 5-lobed or with tendency toward 3-lobed; flowers relatively small, allogamous or autogamous; corolla lobes lacinate to fimbriate; southwestern USA and northwestern Mexico.  $x = 16$ .

## KEY TO SPECIES OF SECT. *SIMIOLA* IN THE USA AND CANADA

1. Fruiting calyces open at the throat, lateral calyx lobes mostly shallowly deltate to merely apiculate or absent, sometimes obscure or obsolete, not turned upward to close the throat.
  2. Perennial, arising from profusely produced, branching, filiform rhizomes; stems erect or basally decumbent-ascending and becoming erect distally; fruiting calyces (10–)11–17(–20) mm ..... 10. *Erythranthe utahensis*
  2. Annual, fibrous-rooted, usually rooting freely at least at the proximal cauline nodes; stems erect, basally decumbent-ascending and becoming erect distally, or stems all prostrate; fruiting calyces 7–14 mm.
    3. Stems more or less quadrangular; distal and bracteal leaves densely villous on abaxial surfaces with vitreous, flattened, multicellular, eglandular hairs; flowers autogamous; western USA ..... 27. *Erythranthe arvensis*
    3. Stems subterete; distal and bracteal leaves glabrous or villous-glandular; flowers allogamous or autogamous; eastern and central USA.
      4. Flowers herkogamous, corolla limb expanded 10–15 mm (pressed); Michigan ..... 5. *Erythranthe michiganensis*
      4. Flowers plesiogamous, corolla limbs expanded 5–8 mm or 1–1.5 mm (pressed); southwestern USA.
        5. Fruiting calyces minutely hirtellous; stems often prostrate to decumbent but becoming fully erect at least in the inflorescence, commonly distinctly fistulose ..... 4. *Erythranthe inamoena*
        5. Fruiting calyces glabrous to sparsely villous-glandular; stems prostrate to erect, not fistulose.

6. Stems prostrate and forming floating mats to decumbent-ascending to ascending or erect-ascending distally; calyces and pedicels glabrous or sparsely villous-glandular; calyces without purple-dots; tube-throats 6–8 mm, exserted 1–3 mm beyond calyx margins, limb expanded 5–8 mm (pressed) ..... 2. *Erythranthe geyeri*
6. Stems erect to ascending-erect; calyces and pedicels glabrous; calyces purple-dotted; corolla tube-throats 9–12 mm, exserted 3–5 mm beyond calyx margins, limb expanded 1–1.5 mm (pressed) ..... 3. *Erythranthe regni*
1. Fruiting calyces closed at the throat, lower lobes turned upward against the upper lobe.
7. Producing rhizomes or stolons.
8. Corolla lobes lacinate to fimbriate; plants procumbent and mat-forming.
9. Leaves densely villous-hirsute on both surfaces with thickened and flattened, stiff, whitish, gland-tipped hairs, calyces villous-hirsute, pedicels and distal stems stipitate-glandular; lower lip of corolla spreading ..... 33. *Erythranthe parvula*
9. Leaves glabrous to moderately villousulous adaxially, glabrous abaxially, calyces glabrous to sparsely villousulous, pedicels and stems glabrous; lower lip of corolla strongly reflexing .. ..... 34. *Erythranthe chinatiensis*
8. Corolla lobes entire or apically notched; plants procumbent to decumbent or erect to suberect.
10. Rhizomes filiform, usually branching, prolifically produced and forming a mass.
11. Leaves distinctly hirsutulous to softly hirsute on both surfaces with sharp-pointed, thick-walled, eglandular, and dull gray hairs ..... 9. *Erythranthe corallina*
11. Leaves glabrous to sparsely villous-glandular or stipitate-glandular on both surfaces with blunt-tipped, thin-walled, minutely gland-tipped, and vitreous hairs.
12. Flowers 6–16, from proximal to distal nodes; corolla tube-throats 10–13 mm; fruiting pedicels (25–)40–75 mm; stems erect, 20–50 cm ..... 10. *Erythranthe utahensis*
12. Flowers 1–3(–5) from distal nodes; corolla tube-throats 9–11 or 15–25 mm; fruiting pedicels 10–35(–40) mm; stems erect to erect-ascending or procumbent to decumbent or decumbent-ascending, 2–35 cm.
13. Stems procumbent or decumbent to decumbent-ascending, 3–10 cm, forming matted colonies; leaf blades 3–12 mm long, margins entire to mucronulate or barely denticulate; corolla tube-throats 15–18 mm ..... 7. *Erythranthe caespitosa*
13. Stems erect to erect-ascending, (2–)5–35 cm, plants solitary to weakly colonial; leaf blades mostly 5–35(–55) mm long, margins distinctly serrate to serrate-dentate or denticulate; corolla tube-throats 9–11 or 15–25 mm.
14. Corolla tube-throats 15–25 mm, exserted 5–10 mm beyond the calyx margin ..... 6. *Erythranthe tilingii*
14. Corolla tube-throats 9–11 mm, exserted 1(–2) mm beyond the calyx margin ..... 8. *Erythranthe minor*
10. Rhizomes broader than filiform, usually 1-few, not highly branched and forming a mass.

15. Lower cauline leaves narrowly oblong-obovate or oblong-elliptic to oblong-lanceolate, usually 3–4 times longer than wide, bases attenuate, margins shallowly and evenly callous-dentate; plants completely glabrous throughout; Columbia River region of Oregon .....

..... 18. *Erythranthe scouleri*

15. Lower cauline leaves ovate to ovate-elliptic or broadly elliptic, usually 1–2 times longer than wide, bases rounded to truncate, margins shallowly and evenly callous-dentate (*E. decora*) or prominently and often irregularly dentate; plants glabrate to hirtellous or glandular-villous.

16. Leaf blades uniformly ovate-triangular to ovate-lanceolate with truncate bases, palmately (3–)5–7-veined; corolla tube-throats 18–26 mm; stems, pedicels, calyces, and leaf surfaces minutely hirtellous .....

..... 17. *Erythranthe decora*  
16. Leaf blades ovate-elliptic to ovate or suborbicular, with cuneate to rounded bases, subpinnately veined; corolla tube-throats (10–)12–20 mm or (14–)16–24 mm; vestiture of stems, pedicels, calyces, and leaf surfaces variable.

17. Stems (6–)15–65(–80) cm; pedicels, calyces, and distal stems variable in vestiture but not puberulent-glandular; corolla tube-throats (10–)12–20 mm, exserted 3–5 mm beyond the calyx margin; fruiting calyces 11–17(–20) mm .....

..... 11. *Erythranthe guttata*

17. Stems (25–)50–120(–160) cm; pedicels, calyces, and distal stems densely puberulent with a mix of crinkly hairs and minutely stipitate-glandular hairs; corolla tube-throats (14–)16–24 mm, exserted (8–)10–15 mm beyond the calyx margin; fruiting calyces 15–22(–25) mm .....

..... 12. *Erythranthe grandis*

7. Fibrous-rooted or taprooted, without rhizomes or stolons.

18. Corollas relatively large, chamogamous, tube-throats (6–)8–23 mm, exserted (2–)3–8 mm (sometimes 1 mm in smallest corollas of *E. microphylla*) beyond the fruiting calyx margin; fertilization allogamous (anther pairs at different level, stigma above upper anther pair) or (in *E. thermalis*) autogamous.

19. Stems moderately to densely villous-glandular, at least proximally

20. Taprooted; stems, leaves, calyces, and pedicels moderately villous-glandular, without eglandular hairs; fruiting pedicels 15–45 mm; corolla tube-throats narrowly cylindric-funnelform .....

..... 20. *Erythranthe marmorata*  
20. Fibrous-rooted; stems, leaves, calyces, and pedicels moderately villous-glandular with gland-tipped hairs or mixed hirtellous and stipitate-glandular; fruiting pedicels 7–17 mm; corolla tube-throats infundibular.

21. Corollas tube-throats 11–20 mm, exserted 4–8 mm beyond the calyx margin; allogamous; coastal and near-coastal localities in Monterey, San Luis Obispo, and Santa Cruz cos., California .....

..... 13. *Erythranthe arenicola*

21. Corollas tube-throats 8–12 mm, exserted 1–2 mm beyond the calyx margin; autogamous; Yellowstone Natl. Park, Wyoming .....

..... 14. *Erythranthe thermalis*

19. Stems delicately and minutely stipitate-glandular or glabrous to glabrate.

22. Corollas pale yellow to nearly white, palate dense-dark yellow, drying blue-green, tube-throats 9–14 mm; southern Arizona, New Mexico, Mexico

..... 16. *Erythranthe unimaculata*

22. Corollas, including the palate, usually nearly evenly yellow, tube-throats (6–)8–23 mm; California, Nevada, Oregon, Washington, British Columbia.

23. Basal and proximal cauline leaves with blades lanceolate or oblong-lanceolate to ovate, distal narrower, narrowly spatulate to oblanceolate, 5–15(–30) mm x 1–5 mm; plants glabrous or stems, leaves, and pedicels minutely stipitate-glandular with hairs 0.05–0.1 mm, at least just above the nodes; Colusa, Glenn, Lake, Mendocino, Napa, and Sonoma cos., California .....

..... 22. *Erythranthe nudata*

23. Basal and proximal cauline leaves with blades ovate or ovate-lanceolate to elliptic-ovate, orbicular-ovate, suborbicular, or depressed-ovate, (3–)10–45 mm x 3–35 mm; plants glabrous and glaucous to hirtellous-glandular; distribution various.

24. Distal cauline leaves distinct, petioled or subclasping to narrowly perfoliate; stems and leaf surfaces not at all glaucous, stems and pedicels hirtellous or mixed hirtellous and stipitate-glandular, sometimes only short villous-glandular with gland-tipped hairs, sometimes completely glabrous below the inflorescence; corolla tube-throats (6–)8–16(–20) mm; California, Nevada, Oregon, Washington, British Columbia .....

..... 19. *Erythranthe microphylla*

24. Distal cauline leaves distinctly connate-perfoliate and forming a flat disc; stems and leaf surfaces glabrous and glaucous; corolla tube-throats 12–23 mm; Butte and Tehama cos., California .....

..... 21. *Erythranthe glaucescens*

18. Corollas relatively small, sometimes cleistogamous, tube-throats 4–14 mm, exerted 1–3 mm beyond the fruiting calyx margin; fertilization autogamous (anther pairs and stigma at about the same level).

25. Corolla tube-throats 7–14 mm, limb expanded 6–16 mm, apparently chasmogamous.

31. Distal leaves strongly auriculate-clasping and closely paired; flowers produced at distal nodes; stems glabrous.

32. Stems glabrous or sometimes minutely hirtellous in the inflorescence with deflexed hairs, eglandular; flowers 3–8(–16), from remote distal nodes; fruiting calyces (7–)9–14 mm; California, Nevada, Oregon, Washington, Idaho

..... 27. *Erythranthe arvensis*

32. Stems sparsely and minutely stipitate-glandular; flowers (5–)12–16 in bracteate racemes; fruiting calyces (8–)15–18(–20) mm; Arizona, New Mexico, Texas, Colorado, Utah, Nevada; Mexico .....

..... 29. *Erythranthe cordata*

31. Distal leaves not distinctly auriculate-clasping; flowers commonly from distal to proximal nodes; stems glabrous to sparsely hirtellous and/or finely villosulous-glandular.

33. Stems sparsely but distinctly finely villosulous-glandular proximally to distally; leaves finely villosulous-glandular .....

..... 25. *Erythranthe pardalis*

33. Stems glabrous to sparsely hirtellous, finely villosulous-glandular above the nodes but not elsewhere; leaves eglandular.

34. Leaves as long as wide or wider than long (blades elliptic-ovate to broadly ovate, suborbicular, or depressed ovate), margins irregularly dentate to dentate-serrate or nearly lacerate-dentate, commonly doubly toothed; plants commonly producing tiny cleistogamous flowers on branches separate from those with larger flowers, corolla tube-throats (5-)8-12 mm ..... 23. *Erythranthe nasuta*

34. Leaves longer than wide (blades elliptic to elliptic-obovate, oblanceolate, or oblong), margins commonly narrowly pinnately lobed or dissected, sometimes merely shallowly toothed; plants producing flowers of only one size, corolla tube-throats 4-6 mm ..... 24. *Erythranthe laciniata*

25. Corolla tube-throats 4-10 mm, limb barely expanded or only 3-4 mm, clearly cleistogamous.

26. Fruiting calyces 6-10 mm, lobes usually 3 or 3-5 on the same plant, if 5 then with the 2 middle lobes much smaller than the lower pair ..... 38. *Erythranthe calciphila*

26. Fruiting calyces mostly (7-)10-15 mm, lobes 5, all about equal size or the upper slightly longer.

27. Flowers and fruits subsessile to sessile, pedicels shorter than subtending leaves or essentially absent; Nye Co., Nevada ..... 28. *Erythranthe brachystylis*

27. Flowers and fruits distinctly pedicellate, pedicels longer than subtending leaves; more widely distributed.

28. Distal leaves short-petiolate, hirsute to hirsutulous at least on adaxial surface; stems villosulous-glandular area at each axil, sometimes hirtellous distally; fruiting calyces with upper lobe usually distinctly longer than the lower and slightly falcate ..... 23. *Erythranthe nasuta*

28. Distal leaves sessile or short-petiolate, glabrous or villous on one or both surfaces; stems usually glabrous; fruiting calyces with upper lobe not distinctly longer or falcate.

29. Fruiting calyces glabrous; (5-)7-10 mm ..... 31. *Erythranthe hallii*

29. Fruiting calyces minutely hirtellous, (7-)9-14 mm.

30. abaxial surfaces of distal and bracteal leaves densely villous with long, vitreous, flattened, eglandular, multicellular hairs; middle and upper cauline leaves depressed-ovate to nearly reniform, distal sessile; stems, leaves, and calyces usually green; fruiting calyces commonly remaining open; stems erect to ascending, often rooting at lower nodes

..... 27. *Erythranthe arvensis*

30. leaves glabrous or proximal leaves sometimes sparsely villous; middle and upper cauline leaves ovate to ovate-lanceolate, distal short-petiolate; stems, leaves, and calyces commonly dark purplish; fruiting calyces closing; stems erect or ascending-erect, not rooting at lower nodes

..... 30. *Erythranthe charlestonensis*

KEY TO SPECIES OF SECT. *SIMIOLA* IN MEXICO

1. Fruiting calyces open at the throat, lateral calyx lobes mostly shallowly deltate to lacking or merely apiculate, sometimes obscure or obsolete, lower lobes not curving upward in fruit.

2. Fruiting calyces 10–13 mm, corolla tube-throats (7–)12–16 mm ..... 1. *Erythranthe glabratus*

2. Fruiting calyces 4–12 mm, corolla tube-throats 5–11 mm.

3. Fruiting calyces 4–6 mm, corolla tube-throats 5–6 mm; leaf surfaces puberulent-glandular

..... 39. *Erythranthe visibilis*

3. Fruiting calyces 7–14 mm, corolla tube-throats 6–12 mm; leaf surfaces glabrous.

4. Stems more or less quadrangular ..... 27. *Erythranthe arvensis*

4. Stems subterete.

5. Stems usually prostrate in flower, forming floating mats, occasionally becoming distally ascending-erect to erect, not distinctly fistulose; flowers 2–8(–12), usually from distal nodes but sometimes from most of them, very loosely racemose; corolla tube-throats 6–8 mm; fruiting pedicels 18–30 mm; fruiting calyces obtriangular to broadly obtriangular or deeply cupulate, glabrous to sparsely villous-glandular ..... 2. *Erythranthe geyeri*

5. Stems often prostrate to decumbent but becoming fully erect at least in the inflorescence, commonly distinctly fistulose; flowers (6–)8–18(–24), loosely to densely racemose, usually from distal nodes but sometimes from all nodes; corolla tube-throats 7–11 mm; fruiting pedicels 9–20 mm; fruiting calyces broadly cylindric-campanulate, minutely hirtellous ..... 4. *Erythranthe inamoena*

1. Fruiting calyces closed at the throat, lateral lobes present or absent, lower lobes curving upward in fruit against the upper lobe.

6. Stems mostly erect or ascending-erect from the base.

7. Stems 4–30 cm; calyces 3-lobed; corolla tube-throats 5–7 mm .. 38. *Erythranthe calciphila*

7. Stems 2–65(–100) cm; calyces 5-lobed; corolla tube-throats (in *E. nasuta* 5–8–20(–26) mm.

8. Rhizomatous or consistently rooting from proximal nodes.

9. Rhizomatous; corolla tube-throats (10–)12–20(–26) mm, exserted 3–5 beyond calyx margin, limb expanded 12–24(–25) mm (pressed); styles 15–20 mm, exserted 6–9 mm beyond fruiting calyx margin; stigma above level of anthers, allogamous ..... 11. *Erythranthe guttata*

9. Rooting from proximal nodes; corolla tube-throats 8–14 mm, exserted 1–3 mm beyond calyx margin, limb expanded 9–14 mm (pressed); styles 7–10 mm, exserted 1–3 beyond fruiting calyx margin; stigma at same level as anthers, autogamous ..... 29. *Erythranthe cordata*

8. Fibrous-rooted.

10. Corolla limb distinctly bilabiate, 7–17 mm wide (pressed); flowers herkogamous-allogamous; blade margins relatively evenly shallowly serrate-dentate to serrate, 1-toothed; pedicels villous glandular along whole length.

11. Corolla tube-throats exerted 3–4 mm beyond the calyx margin, palate and lower throat densely and dark yellow, drying blue-green, limbs expanded 8–17 mm wide (pressed); Arizona, New Mexico, Chihuahua Sonora . 16. *Erythranthe unimaculata*
11. Corolla tube-throats exerted 4–6(–7) mm beyond calyx margin, palate and lower throat not of a different color or hue, limbs expanded 7–10 mm wide (pressed); Baja California Sur ..... 15. *Erythranthe lagunensis*
10. Corolla limb weakly bilabiate, 4–12 mm wide (pressed); flowers plesio- autogamous; blade margins irregularly dentate to dentate- serrate or nearly lacerate- dentate, commonly doubly toothed; pedicels sparsely glandular-villous just above the nodes, otherwise glabrous.
12. Stems quadrangular; upper calyx lobe characteristically elongate, beaklike, margins entire; corolla lobe margins entire ..... 23. *Erythranthe nasuta*
12. Stems terete; upper calyx lobe relatively short, often with 1-2 pairs of tiny teeth on the distal margins; corolla lobe margins sparsely denticulate ..... 26. *Erythranthe brevinasuta*
6. Stems mostly procumbent, often rooting at the nodes, becoming erect in the inflorescence.
13. Corolla lobes fimbriate.
14. Leaves glabrous or rarely sparsely villosulous adaxially; stamen pairs at different levels, stigma above upper anther pair, allogamous ..... 32. *Erythranthe dentiloba*
14. Leaves densely villous-hirsute to glabrous; both stamen pairs and the stigma at essentially the same level, autogamous.
15. Leaves densely villous-hirsute on both surfaces with thickened and flattened, stiff, whitish, gland-tipped hairs, calyces villous-hirsute, pedicels and distal stems stipitate- glandular; lower lip of corolla spreading ..... 33. *Erythranthe parvula*
15. Leaves glabrous to moderately villosulous adaxially, glabrous abaxially, calyces glabrous to sparsely villosulous, pedicels and stems glabrous; lower lip of corolla strongly reflexing ..... 34. *Erythranthe chinatiensis*
13. Corolla lobes entire or emarginate.
16. Stems, pedicels, calyces, and leaf surfaces moderately to densely villous-glandular to villosulous-glandular with hairs mostly 1–3 mm long; calyces 5-lobed ..... 37. *Erythranthe pennellii*
16. Stems, pedicels, calyces, and leaf surfaces glabrous, or if glandular (*E. visibilis*) hairs mostly 0.2–0.8 mm long; calyces 3-lobed or essentially 3-lobed.
17. Fruiting calyces 4–6 mm; corolla tube-throats 5–6 mm; leaf surfaces puberulent- glandular ..... 39. *Erythranthe visibilis*
17. Fruiting calyces 5–10 mm; corolla tube-throats 5–12 mm; leaf surfaces glabrous.
18. Fruiting pedicels 5–30 mm; fruiting calyces 5–8 mm; corolla tube-throats 5–9 mm, limbs 6–10 mm broad (pressed); autogamous ..... 35. *Erythranthe madrensis*
18. Fruiting pedicels 25–60 mm; fruiting calyces 6–10 mm; corolla tube-throats 8–12 mm, limbs 8–12 broad (pressed); allogamous ..... 36. *Erythranthe pallens*

1. **ERYTHRANTHE GLABRATA** (Kunth) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus glabratus* Kunth, Nov. Gen. Sp. (quarto ed.) 2: 370. 1817. TYPE: MEXICO. [Hidalgo]. "Crescit prope Moran Mexicanorum, alt. 1330 hex. Floret Majo," *Humboldt and Bonpland s.n.* (holotype: B? or P?). "Type collection apparently not represented at the Museum d'Histoire Naturelle at Paris, France, and actual type at the Berlin Botanical Garden in Germany not verified."

Perennials, rhizomatous, all parts glabrous. Stems erect to decumbent-ascending, commonly emergent, (10-)25–50(–60) cm, commonly slightly fistulose, rooting at the nodes. Leaves cauline, basal usually absent at flowering, lower cauline or proximal to midcauline petiolate, petioles 5–20 mm, distal sessile, not connate, blades palmately 5–7 veined or proximal sometimes subpinnate, proximal broadly ovate, 25–50 mm, medial and distal orbicular to depressed-ovate, 10–40 mm, apices rounded, bases cuneate to rounded or subtruncate, margins shallowly dentate or dentate-serrate to merely mucronulate, with 8–12 teeth per side, rarely subentire. Flowers (4-)6–12, mostly from distal nodes. Fruiting pedicels 10–30(–40) mm. Fruiting calyces broadly campanulate-cylindric, 10–16 mm, not closing, sometimes purple-spotted or purple-tinged, lobes 5, the upper longest, apices rounded or rounded-mucronate. Corollas yellow, red-dotted, tube-throats narrowly funnellform, 9–13 mm, exerted 1–3 beyond the calyx margin, limb bilabiate, expanded. Plesiogamous; anther pairs at about the same level, stigma at or slightly below the anthers. Capsules 8–10 mm.  $2n = 62$ .

Flowering (Jan-)Apr–Jul (–Aug, –Nov). Inundated places, lake and river sides, marshy areas, shallow ditches, moist gravel, steep arroyo banks, disturbed forest, roadsides; (500–, 1300–)1700–2800(–3200) m; Mexico, Guatemala, Nicaragua, South America (Colombia). Apparently completely absent between Guatemala and Colombia except for a single known locality in north-central Nicaragua (Sutton & Hampshire 2001). Map 1.

A detailed allozyme study of the *Mimulus glabratus* complex (Vickery 1990) indicates that four distinct groups can be recognized within what is identified here as *Erythranthe glabrata*, all with  $2n = 62$ . As termed by Vickery, the (1) "Sierra Madre Occidental group" and the (2) "Chiapas-Guatemala group" have a sister relationship and together are sister to the (3) "Colombia group." Although the (4) "Sierra Madre del Sur group" is seemingly geographically interposed between 1 and 2, it is sister to the "Rio Grande group," which has a chromosome number of  $2n = 60$  and is the primarily Texan taxon recognized here as *Erythranthe inamoena*. The type of *M. glabratus* Kunth was collected in Hidalgo in south-central Mexico, thus that name in its strictest sense refers to the Sierra Madre del Sur group. These subgroups have not been distinguished in the present study.

The correct name for the most of the South American plants (south of Colombia) sometimes identified as *Mimulus glabratus* is *M. andicola* Kunth (= *Erythranthe andicola*). *Mimulus andicola* Kunth (1817) and *M. tener* Phil. (1891) were treated as synonyms of *M. glabratus* var. *glabratus* by Grant (1924). *Mimulus glabratus* var. *parviflorus* (Lindl.) A.L. Grant, *M. glabratus* var. *micranthus* (Phil.) B. Boivin, and *M. glabratus* var. *externus* Skottsb. are typified by South American plants.

2. **ERYTHRANTHE GEYERI** (Torrey) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus geyeri* Torrey in Nicotlet, Rep. Hydrogr. Upper Mississippi, 157. 1843. TYPE: USA. North Dakota. [Ramsey Co.] Fresh water springs about Devil's Lake, 1 Aug 1839, C.A. Geyer 119 (holotype: NY digital image! photo-PH!; isotypes: MO digital image!, PH!, US digital image!).

*Mimulus jamesii* Torrey & Gray ex Benth., Prodr. (DC.) 10: 371. 1846. *Mimulus glabratus* var. *jamesii* (Torrey & Gray) Gray, Synopt. Fl. N. Amer. ed. 2, 2(1): Suppl. 447. 1886. LECTOTYPE (Pennell 1935): USA. Iowa. [Pottawatomie Co.] "Ad fontes plantiorum Missouriensium," along the Missouri River, 27 May 1820, James s.n. (NY digital image! photo-PH!; islectotype: MO digital image!). Three collections were cited in the protologue:



"Ad fontes planitiorum Missouriensium (James!, Engelmann!), ad Devils Lake (iter Nicollet)." Pennell (1935, p. 120) noted that "Type, a specimen collected by Edwin James (according to his journal) in the present Pottawatomie County, Iowa, seen in Herb. New York Botanical Garden." At varietal rank within *M. glabratus*, the autonym var. *jamesii* has priority over var. *fremontii*.

*Mimulus reniformis* Engelm. ex Benth., Prodr. (DC.) 10: 371. 1846 [name only, included by Bentham in synonymy of *Mimulus jamesii*: "M. reniformis Engelm. mss."].

*Mimulus jamesii* var. *fremontii* Benth., Prodr. (DC.) 10: 371. 1846. *Mimulus glabratus* var. *fremontii* (Benth.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 190. 1924. TYPE: USA. Wyoming. [Laramie Co.:] "In montium Windriver praeruptis," Rocky Mountains, 14 Jul 1842, J.C. Fremont s.n. (holotype: NY digital image! photo-PH!). Pennell (1935, p. 120) noted "Type, dated July 14, 1842, seen in Herb. New York Botanical Garden; from a manuscript also at that institution it appears that on that day Fremont was not in the Wind River Mountains, but actually on the high plains of what is now Laramie County, Wyoming."

*Mimulus glabratus* var. *oklahomensis* Fassett, Rhodora 41: 525. 1939. TYPE: USA. Oklahoma. Caddo Co.: Hinton, in Caddo Canyon, 26 Apr 1936, D. Demaree 12338 (holotype: GH; isotype: MO!).

**Perennials**, rhizomatous, vestiture (in the northern part of the range, USA) of calyces, pedicels, and adaxial surfaces of distal leaves sparsely short-villous-glandular or (in New Mexico and Mexico) completely glabrous. Stems usually prostrate and forming floating mats, sometimes decumbent-ascending to ascending or erect-ascending distally, (3–)10–40 cm, rooting at the nodes. Leaves cauline, basal absent at flowering, blades palmately 3–5-veined, suborbicular to depressed-ovate or broadly elliptic-ovate to reniform, 6–25 mm × 5–30 mm, relatively even-sized or largest often at midstem, bracteal reduced, margins shallowly dentate to crenate-dentate with 3–7(–10) teeth per side, apex rounded, base cuneate to truncate or subcordate, all leaves short-petiolate or the distal sessile, petioles 3–10(–20) mm. Flowers 2–8(–12), usually from distal nodes but sometimes from most of them, very loosely racemose. Fruiting pedicels 18–30 mm. Fruiting calyces obtriangular to broadly obtriangular or deeply cupulate, (7–)8–12 mm, lateral lobes shallowly convex-mucronulate, not closing the throat, upper lobe ovate with rounded apex. Corollas yellow, sparsely red dotted or without red dots, tube-throats cylindric-funneliform, 6–8 mm, exserted 1–3 mm beyond calyx margins, limb barely bilabiate, expanded 5–8 mm (pressed). Styles glabrous. Plesio gamous; anther pairs at about the same level, stigma at or slightly below the anthers. Capsules (4.5–5 mm in New Mexico) 5–8 mm, stipitate, included.  $2n = 30$ .

Flowering May–Aug(–Oct). Edges of flowing streams, marsh edges, drainage ditches, seepage areas, springs, muddy or moist banks; 200–2500 m (1500–2500 m in Arizona and New Mexico); USA, Mexico. Maps 2, 3.

Collections examined from the southwestern corner of the USA range. **Arizona.** Apache Co.: 2.5 mi NW of Fort Defiance, edges of water in small creek, 8 Oct 1965, *Crutchfield 921* (LL); road crossing of Chinle Creek between Dinnehotso and Mexican Water, 4900 ft, moist sand along stream, 17 Jul 1948, *Gould & Phillips 4797* (ARIZ); Canyon de Chelly Natl. Monument, sandy soil alongside stream in upper Canyon de Chelly, 6500 ft, 25 Jul 1971, *Halse 526* (ARIZ); 1 mi W of Tsaile Peak, 7500 ft, wet sites, 23 Aug 1934, *Howell 33* (ARIZ). **Pinal Co.:** Sacaton, "Little Gila," 2 Jun 1927, *Harrison 4201* (ARIZ).

Collections examined from Texas: **Grayson Co.:** at Carpenters Bluff, in spring, 23 Apr 1951, *Gentry 51-1382* (TEX). **Hemphill Co.:** Gene Howe Wildlife Management Area, 7 mi NE of Canadian, locally frequent in standing water of Persimmon Creek, 4 Jun 1957, *Rowell 5305* (TEX).

*Erythranthe geyeri* has commonly been regarded as conspecific with *E. glabrata* (as *Mimulus glabratus* var. *jamesii*), but typical *E. glabrata* has a different chromosome number and is sharply

distinct in morphology, and the two are broadly sympatric in Mexico without intermediates. The allozyme study of the *Mimulus glabratus* complex (Vickery 1990) indicates that the USA Great Plains populations of *E. geyeri* are distinct from those in New Mexico and Mexico. Such a distinction is not made here but a study is needed to see if morphological evidence parallels the allozyme data.

Fassett distinguished *Mimulus glabratus* var. *oklahomensis* on the basis of its "flowers sometimes as large as those of var. *michiganensis*, with leaves like those of var. *Fremontii* (Benth.) Grant, and with pedicels more than twice as long as the subtending leaves." Besides the type collection in Caddo County, several other distinctly large-flowered collections of *Erythranthe geyeri* have been encountered among Oklahoma collections: Adair Co.: 1 mi SW of Watts on US 59, seepage area in a shaded bluff on Ballard Creek, 6 May 1958, *Wallis 6605* (SMU, TEX); Major Co.: near Cleo, edge of spring, 8 Jun 1913, *Stevens 782* (MO). Woodward Co.: Woodward, small, effluent stream from Boiling Springs, 2600 ft, 9 Aug 1964, *Vickery 2659*, cult. 7132, voucher for  $2n = 30$  (UT).

These Oklahoma variants have flowers only at distalmost nodes and corolla tubes 10–11 mm long with limbs expanded 6–8 mm (pressed). The plants from Major County were collected past flower but the fruiting calyces are 12–13 mm long. The stems are erect from the base and produce rhizome-like runners from basal nodes. Large flowers suggest that these plants could be polyploid and their seemingly clustered geographic occurrence, apparently sympatric with typical *Erythranthe geyeri*, further suggests that they may represent an evolutionarily distinct entity. On the other hand, a chromosome count from a Woodward County collection is diploid and the relatively larger flowers apparently are autogamous, with anthers and stigma at the same level. Two other collections from the Boiling Springs area have smaller corollas of typical *E. geyeri* but have stigmas slightly above (ca. 1.5 mm) the level of upper anthers: Woodward Co.: Boiling Springs State Park: common in spring fed stream, 2 May 1953, *Goodman 5639* (SMU, UC); in stream below the spring-house, 1 May 1953, *Waterfall 11410* (SMU, TEX, UC).

In 1976, Vickery identified var. *oklahomensis* as the Great Plains variant of *Mimulus glabratus* (Hsu & Vickery 1976), and he later (Vickery 1984) cited collections that he identified as var. *oklahomensis* from Reno and Scott counties, Kansas, and from Custer and Thomas counties, Nebraska. He did not provide the criteria he used in identification of var. *oklahomensis*.

**3. ERYTHRANTHE REGNI** Nesom, sp. nov. TYPE: USA. Arizona. Yuma Co.: Kofa Mountains, ca. 50 mi N of Yuma, SE of Stone Cabin on Kofa Game Range at Horse Tank, wet soil surrounding pool, 16 Mar 1975, *W.E. Booth A-142* (holotype: ARIZ!).

Similar to *Erythranthe geyeri* in its open mature calyces, cleistogamous flowers, (in part in its) glabrous vestiture but different in its erect habit, apparently annual duration, larger leaves, purple-dotted calyces, and corollas with longer tube-throats and barely bilabiate limb.

Similar to *Erythranthe glabrata* in its open mature calyces, cleistogamous flowers, erect habit, prominently punctate leaves, and glabrous vestiture but different in its smaller calyces and corollas, flowers from all nodes, broader leaves (ratio) with fewer teeth, and annual duration.

Similar to *Erythranthe arvensis* in its erect habit, annual duration, open mature calyces, cleistogamous flowers but different in its glabrous vestiture and punctate leaves.

Similar to *Erythranthe cordata* in its erect habit and cleistogamous flowers but different in its glabrous vestiture, open mature calyces, and punctate leaves.

**Annuals**, fibrous-rooted, sometimes rooting at proximal nodes, completely glabrous. **Stems** erect to ascending-erect, 15–45 cm, sometimes becomes slightly fistulose. **Leaves** basal and cauline, basal petiolate, petioles 5–25(–30) mm, midcauline and distal sessile, not connate, blades palmately 5–7-veined or proximal sometimes subpinnate, largest basal or at midstem with distal slightly reduced, proximal ovate to depressed-orbicular, 15–20(–50) mm x 15–25(–50) mm, in size, medial and distal broadly depressed-ovate to obtriangular or flabellate, 15–35 x 15–40 mm, margins shallowly serrate-dentate, sometimes irregularly, to mucronulate or apiculate with (3–)5–7 teeth per side, rarely subentire, apices rounded, bases attenuate-cuneate. **Flowers** 6–16, from all nodes or from medial to distal. **Fruiting pedicels** 15–30 mm. **Fruiting calyces** broadly campanulate-cylindric, 7–9 mm, sparsely purple-dotted, lobe apices acute to obtuse-mucronulate, not closing the throat, upper lobe longest. **Corollas** yellow, apparently without red dots, tube-throats cylindric-funneliform, 9–12 mm, exerted 3–5 mm beyond calyx margins, limb barely bilabiate or not at all, expanded 1–1.5 mm (pressed). **Styles** glabrous. **Plesio**gamous; anther pairs and stigma at about the same level. **Capsules** 4–5 mm, sessile, included.

Flowering Mar–May. Moist to wet, sandy loam soil; ca. 2800–3200 ft; Ariz.

Additional collections examined. **Arizona**. Yuma Co.: Kofa Mts., Kofa Game Range, in extremely moist, sandy loam soil, 2800 ft, 15 Apr 1953, *Crandall 150* (ARIZ); Kofa Mts., Kofa Game Refuge, High Tank 8, Upper Burro Canyon, 3200 ft, 31 Mar 1970, *Furlow 24* (ARIZ).

*Erythranthe regni* is endemic to the Kofa Mountains of Yuma County — all collections have been made from the Kofa Game Refuge. The epithet (genitive of *regnum*, kingdom) alludes to the Kofa Mountains, which are arid, volcanic remnants of Tertiary age. "Kofa" is a near acronym for the old King of Arizona gold mine, which stamped its property "K of A." The monkeyflower localities apparently are at higher elevations in the mountains — the three highest peaks in the area at about 1500 meters, 1350 meters, and 1100 meters.

4. **ERYTHRANTHE INAMOENA** (Greene) Nesom, *Phytoneuron* 2012-40: 44. 2012. *Mimulus inamoenus* Greene, *Pittonia* 5: 137. 1903. **TYPE:** USA. Texas. [Jeff Davis Co.]; Limpia Canyon, 25 Apr 1902, *S.M. Tracy & F.S. Earle 220* (holotype: ND-Greenel, photo-PH!; isotypes: MO!, PH!, TEX!, US digital image!).

*Mimulus jamesii* var. *texasensis* A. Gray, *Syn. Fl. N. Amer.* 2(2): 277. 1878. **LECTOTYPE** (Pennell 1935, p. 118): USA. Texas. [Travis Co.]; Austin, Apr 1843, *C. Wright s.n.* (GH; isoclectotype: NY digital image!). The protologue noted only "Texas, Wright, Lindheimer, &c." — Pennell noted "Type, collected by Charles Wright at Austin, Texas in April, 1843, seen in Gray Herbarium of Harvard University."

**Annuals**, fibrous-rooted, rooting at proximal nodes and sometimes forming matlike colonies; stems, leaves, pedicels and calyx glabrous or the calyx hirtellous. **Stems** decumbent to decumbent-ascending at the base, becoming fully erect at least in the inflorescence, 10–30 cm, commonly distinctly fistulose (fleshy and hollow), mostly simple or few-branched from proximal nodes. **Leaves** basal and cauline or sometimes the basal deciduous by flowering, basal and lower to mid cauline petiolate, subsessile to sessile distally, blades ovate to broadly ovate or elliptic-ovate, (5–)15–35(–60) x (4–)10–35(–50) mm, becoming subreniform distally, margins dentate-serrate to shallowly dentate, 5–11 teeth per side, apex obtuse to rounded, base truncate to subcordate, petioles 10–70 mm. **Flowers** (6–)8–18(–24), loosely to densely racemose, sometimes produced from all nodes. **Fruiting pedicels** 9–20 mm, straight. **Fruiting calyces** broadly cylindric-campanulate, 7–11 mm, 5–9 mm wide (pressed), greenish or commonly purple-spotted, minutely hirtellous and scabrous, broadly cylindric, lobes deltate to shallowly deltate, lower slightly upturned (10°–45°) but not closing the throat, spreading ca. 45°, or sometimes deflexed 40°. **Corollas** yellow, red-spotted, tube-throats cylindric, 7–11 mm, exerted (1–)2–3(–4) mm beyond calyx margins, limb bilabiate, slightly

expanded. Styles glabrous. Plesio gamous; anther pairs at about the same level, stigma at or slightly below the anthers. Capsules 4.5–6 mm, stipitate, included.  $2n = 60$ .

Flowering Jan–Apr(–May). Edge of seeps and creeks, mud or gravel, shallow running water, wet crevices, canyon drainages; 800–2200 m in the trans-Pecos region and adjacent Mexico, 100–400 m in the Edwards Plateau. Texas; Mexico (Chihuahua, Coahuila). Map 3.

Chromosome vouchers. USA. Texas. Llano Co.: base of Enchanted Rock, sandy and rocky soil along spring fed stream, 1500 ft, 8 Jul 1960, *Vickery 2626*, cult 6278, voucher for  $n = 30$  (UT); Enchanted Rock State Park, sand along stream, 1300 ft, 9 Apr 1966, *Vickery 2709*, cult. "7326 = 6278," voucher for  $n = 30$  (UT).

Collections examined. USA. Texas. Numerous collections from almost every county indicated on Map 3. MEXICO. Chihuahua. Sierra de Hechiceros, Canon Encampanado, below (E) of Rancho Encampanado and above (W) of jet with Canon de Indio Felipe, canyon bottom woods with perennial stream, dry igneous mountains, along stream, 1300–1400 m, 27 Jul 1974, *Wendt & Adamcewicz 418* (TEX); Arroyo La Cristina, 0.3 mi up (E) from Mina Cerro Verde along road to Falomir, N of W part of Sierra Chorreras, 1200 m, arroyo with perennial water, general area of desert scrub, 22 Mar 1975, *Wendt & Lott 752* (TEX). Coahuila. Mpio. Zaragoza, Serranias del Burro, upper reaches of Cañon El Bonito, ca. 2.5 km above dam, 1700 m, in accumulations of soil in bed of drainage flowing over metamorphosed limestone in oak-pine woodland, 11 Apr 1976, *Riskind & Patterson 1946* (TEX); Sierra Maderas del Carmen, Cañon El Dos, ca. 1 mi below (SE) of Campo Dos, small moist meadow along stream in general area of coniferous forest, rhyolitic area, 2200 m, 3 Apr 1974, *Wendt et al. 129* (TEX); 1.6 mi S of El Club-Piedra Blanca-Huerfanita road that leaves the latter 6.2 mi W of Huerfanita, heading up limestone valley E of Sierra Maderas del Carmen, along small but apparently perennial stream in general area of desert scrub/grassland, 1325 m, 4 Apr 1974, *Wendt et al. 134* (TEX).

*Erythranthe mammoena* is distinctive in its lack of vestiture (usually completely glabrous), short corollas, flowers in racemes with reduced bracts and mostly at distal nodes, short and open-throated fruiting calyces, erect and fistulose stems, and its apparent annual duration (fibrous-rooted but usually rooting at lower cauline nodes).

Pennell (1935) placed *Erythranthe inamoena* (as *Mimulus jamesii* var. *texensis*) as a synonym of typical *E. glabrata*, but the calyces (9–10 mm) and the corollas of the Texas plants are small, more like typical *E. geyeri* (as noted by Greene in the protologue of *Mimulus mammoenus*). Greene also correctly observed the difference in habit between *E. geyeri* (prostrate) and *E. inamoena* (at least flowering axes erect). *Erythranthe inamoena* is tetraploid, in contrast to the diploid *E. geyeri*.

Presumably because of its small corollas with autogamous fertility, *Erythranthe mammoena* has often been confused in identification with *E. cordata*, especially in the trans-Pecos region of Texas where the two are sympatric. The two usually can be distinguished by the following contrasts.

- |   |                             |
|---|-----------------------------|
| 1. Calyces closed at maturity; flowering at distal nodes; pedicels and calyces minutely stipitate-glandular; fruiting calyces (8–)14–18(–20) mm; corolla tube-throats 8–14 mm | <i>Erythranthe cordata</i>  |
| 1. Calyces open at maturity; flowering often at all nodes; pedicels and calyces glabrous; fruiting calyces (7–)8–11 mm; corolla tube-throats 7–11 mm                          | <i>Erythranthe inamoena</i> |

In Brewster, Presidio, and Val Verde counties, however, there are populations identified here as *E. inamoena* (based on proximal-to-distal distribution of flowers and the short mature calyces with open throats) that have sparsely stipitate-glandular pedicels and calyces. These might reflect

introgression from *E. cordata* — typical populations of both species occur in Brewster and Presidio counties, but *E. cordata* has not been recorded from Val Verde County. Collections examined. **Texas.** Brewster Co.: along Calamity Creek, ca. 24 mi S of Alpine, in damp soil beneath bridge, 4500 ft, 2 Apr 1949, Turner 459 (SRSC); Warnock & Johnston 17698 (SRSC). **Presidio Co.:** Hinkley 3547 (SRSC); Henrickson 11280 (TEX); Warnock 18200 (SRSC-2 sheets); Warnock 435 (SRSC); Warnock & Powell 17767 (SRSC). **Val Verde Co.:** Indian Springs, formerly inundated SW-facing slope of large limestone blocks and boulders with large spring, 28 Jun 2002, Poole 4606 (SRSC); 20–30 mi up Devil's River, along river at falls below Tawcett Lodge, frequent in mud, 2450 ft, 3 Apr 1953, Warnock 11268 (SRSC).

5. **ERYTHRANTHE MICHIGANENSIS** (Pennell) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus michiganensis* (Pennell) Posto & Prather, Syst. Bot. 28: 177. 2003. *Mimulus glabratus* subsp. *michiganensis* Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1: 119. 1935. *Mimulus glabratus* var. *michiganensis* (Pennell) Fassett, Rhodora 41: 524. 1939. **TYPE:** USA. **Michigan.** Cheboygan Co.: banks of Niger Creek near Topinabee, 13 Jul 1925, J.H. Ehlers 3240 (holotype: MICH digital image!; isotype: PH!).

**Perennial**, rhizomatous, commonly producing numerous leafy stolons from basal nodes, rooting at distal nodes, sometimes forming mats. **Stems** ascending-erect or basally decumbent, becoming erect in the inflorescence, 12–50(–70) cm, glabrous or minutely hirtellous and stipitate-glandular. **Leaves** cauline, basal absent at flowering, blades palmately 3–5-veined, broadly ovate to broadly ovate-elliptic or suborbicular, 8–30 mm × 7–30 mm, relatively even-sized or diminishing in size distally, bracteal reduced and slightly falcate (as pressed), margins evenly or unevenly dentate-serrate to dentate with 3–8 pairs of teeth per side, apices mostly rounded, bases truncate to cuneate, petioles 1–5(–15) mm, sessile at midstem and distally. **Flowers** 2–14, mostly from distal nodes or from medial to distal nodes. **Fruiting pedicels** 10–25 mm, spreading, villous-glandular to minutely villousulous-glandular. **Fruiting calyces** cylindric-campanulate, 7–10 mm, not closing, upper lobe ca. 2x longer than others and slightly upcurving, puberulous to softly hirtellous, mixed with longer stipitate-glandular hairs. **Corollas** yellow, sometimes faintly red-spotted, tube-throats cylindric-campanulate, 10–14 mm, exerted 5–8 mm beyond the calyx margin, limb bilabiate, expanded 10–15 mm (pressed). **Styles** glabrous. **Herkogamous**; anther pairs distinctly separated in level, stigma 0.5–2 mm above the upper anther pair. **Mature capsules** not observed.  $2n = 30$  or rarely  $2n = 28$  (Bliss 1986).

**Flowering** Jun–Aug(–Oct). Cold calcareous springs, seeps, depressions, streams, alkaline shorelines at the mouth of small drainages, steep moraine slopes, bluff bases, commonly within northern white cedar swamps; 500–900 m; Michigan (Benzie, Cheboygan, Emmet, Leelanau, Mackinac cos.). Map 3.

*Erythranthe michiganensis* is endemic to a small area in the Mackinac Straits and Grand Traverse regions of Michigan — known as extant from 15 sites and from 3 sites where now apparently extinct. Plants of all but one of the populations are essentially pollen-sterile and reproduce through rhizomes; those from the single partially fertile population have only 27–52% pollen stainability and regularly set selfed-fruits in the greenhouse. In interpopulational crosses between pollen-sterile individuals and pollen donor individuals from the partially fertile population, all the flowers survived to fruiting and all set fruit (Posto 2001).

Based on data from allozyme and RAPD studies, morphology, and crossing studies, Posto and Prather (2003) provided evidence in justification of treating *Erythranthe* [*Mimulus*] *michiganensis* at specific rank. It is "distinguished from the only other member of the *Mimulus glabratus* complex in the Upper Midwest, *M. glabratus* var. *jamesii* [= *E. geyeri*], by its relatively short pedicels (less than twice as long as the bracts), relatively large (17–27 mm) and irregularly

spotted corolla, long style (6–14 mm), and large pistil (13–21 mm)." Differences between *E. geyeri* and *E. michiganensis* in the couplet below are as summarized by Posto and Prather.

- |   |                                  |
|---|----------------------------------|
| 1. Pedicels usually more than twice as long as the bracts; corollas 8–18 mm, sparsely spotted on tube; styles 2–6 mm; pistils 5–10 mm .....       | <i>Erythranthe geyeri</i>        |
| 1. Pedicels less than twice as long as the bracts; corollas 17–27 mm, irregularly spotted on lip and tube; styles 6–14 mm; pistils 13–21 mm ..... | <i>Erythranthe michiganensis</i> |

The didynamous stamens of *E. michiganensis* and stigma positioned above the upper anther pair, along with the relatively large corollas with broadly expanded limb, are reflective of its allogamous breeding system and provide another contrast to *E. geyeri*, which is autogamous.

In the RAPD study, Posto and Prather found unique genetic markers in *Erythranthe michiganensis* and that all *E. michiganensis* individuals grouped in a distinct cluster in the UPGMA phenogram, nested among the individuals of *E. geyeri*. This result was consistent with an allozyme analysis by Vickery (1990). The less specialized breeding system of *E. michiganensis* suggests that it was not derived directly from *E. geyeri* and no RAPD evidence appeared to indicate that *E. guttata* was involved in the origin of *E. michiganensis*. The narrow geographic distribution of *E. michiganensis* lies within the wider range of *E. geyeri* and the two are known to co-occur at two sites, apparently without hybridization or morphologically intermediate individuals. A phylogenetic assessment of the Michigan endemic needs to be broadened, although similarities in vegetative morphology and calyx morphology suggest that *E. geyeri* surely must be among the closest relatives.

6. **ERYTHRANTHE TILINGII** (Regel) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus tilingii* Regel, Gartenflora 18: 321, plate 631. 1869. *Mimulus langsdorffii* var. *tilingii* (Regel) Greene, J. Bot. (Brit. & Foreign) 33: 8. 1895. TYPE: USA. California. [Nevada Co.]: "In der Nahe von Nevada-City im Felsengebirge Californiens sammelte," H.S.T. Tiling s.n. (holotype: LE presumably). Regel grew it from seed sent by Dr. Tiling from the vicinity of Nevada City, California. The illustration seems diagnostic although the foliar vestiture would need to be examined to verify that it is not *Erythranthe corallina*.

*Mimulus implexus* Greene, J. Bot. (Brit. & Foreign) 33: 8. 1895. *Mimulus caespitosus* var. *implexus* (Greene) Peck, Man. Pl. Oregon, 655. 1941. LECTOTYPE (designated here): USA. California. [Nevada Co.]: Towards Castle Peak, 27 Jul 1895, E.L. Greene s.n. (ND-Greene 46291!, photo-PH!, photo-UT!; isocototypes: ND-Greene!, UC!). The protologue provided only this: "It usually grows in dense masses among rocks along streamlets, but only in the higher Sierra Nevada of California." Greene noted that he had earlier (Bull. Calif. Acad. 1: 110. 1885) and mistakenly identified these plants as *M. tilingii*. He regarded *M. implexus* distinct particularly in the leaves, which are "not only of unusual thickness and fleshiness of texture; they are entirely covered by translucent dewy-looking particles, so that upon being handled, especially with moist hands, these particles burst, and cover the leaf surface at once with a thick albuminous slime."

*Mimulus veronicifolius* Greene, Leaf. Bot. Observ. Crit. 2: 7. 1909. TYPE: USA. Washington. [Clallam Co.]: Olympic Mountains, along rivulets, 5000 ft, Aug 1895, C.V. Piper 2177 (holotype: ND-Greene!, photo-PH!, photo-UT!). The protologue noted "near implexus, excessively large corollas, 2 inches long and nearly 1.5 inches wide at the orifice." Plants of the type collection are relatively tall and suberect but have the very large corollas and intricately branched system of thin rhizomes characteristic of the species. Calyces and pedicels are minutely hirtellous.

*Mimulus lucens* Greene, Leaf. Bot. Observ. Crit. 2: 7. 1909. LECTOTYPE (designated here): USA. Oregon. [Baker Co.]: Along rivulets in deep woods, Powder River Mts., Aug 1896, C.V. Piper 2518 (ND-Greene 43316!, photo-PH!, photo-UT!; isocototype: ND-Greene!). "Akin

to *M. implexus*, differing by much more slender stems which are weak and decumbent; leaves exactly ovate, truncate or subcordate at base, of such delicately succulent texture as to be clearly transparent when dried under pressure; calyx sparsely and finely villous." In the protologue, Greene cited *Piper* 2518 and 2519; the ND-Greene sheets (*Piper* 2518) have "Type" and "M. lucens Greene" in Greene's handwriting.

*Mimulus implicatus* Greene, Leaf. Bot. Observ. Crit. 1: 189. 1909. TYPE: USA, California. San Bernadino Co.: Mill Creek Falls, in the mountains back of San Bernadino, 5500 ft, 20 Jun 1901, *S.B. Parish* 5063 (holotype: US digital image! Photo-JEPS!, photo-PH!; isotypes: NY digital image!, PH!). The PH label says "5,000 ft" but otherwise has the same collection data.

Perennial, rhizomatous from a mass of yellowish, branching rhizomes. Stems 2–35 cm, ascending-erect, usually freely branched, glabrous to sparsely stipitate-glandular or short glandular-villous. Leaves: blades 5–35 mm (30–55 mm in large-leaved forms), ovate to lanceolate-triangular or narrowly lanceolate (broadly ovate in large-leaved forms), glabrate to sparsely or moderately villous with thick-vitreous eglandular hairs, apex acute to obtuse or rounded, margins irregularly denticulate, palmately 3–5-veined, 1.5–3 cm, upper sessile, not perfoliate; petioles 0–25 mm. Flowers 1–3(–5), in distal axils. Fruiting pedicels 15–35(–40) mm, sparsely stipitate-glandular to short glandular-villous. Fruiting calyces broadly campanulate, 11–15 mm, closing, glabrous to sparsely stipitate-glandular or short glandular-villous, villous at the sinuses, generally purple-tinged and purple-dotted, lobes broadly ovate, blunt, unequal, the lower ones usually longer than the lateral, the upper at least twice as long as the others. Corollas yellow, red-dotted, tube-throats 15–28 mm, exerted 5–10 mm past calyx margin, limb bilabiate, expanded 14–30 mm across (pressed). Styles hirtellous. Herkogamous; anther pairs at different levels, stigma above upper anther pair. Capsules 5–7 mm, stipitate, included.  $2n = 28, 56$ .

Vouchers at UT for chromosome counts by Vickery:  $2n = 28$  (California, El Dorado Co., Mono Co.; Utah, Salt Lake Co.);  $2n = 56$  (Utah, Utah Co., Vickery 2714, cult. 7493).

Flowering Jul–Sep. Seeps, springs, streambanks, shallow rivulets, cliff bases, ledges and crevices, steep gravelly slopes, wet meadows; 6200–11,400 ft [1400–3400 m]. Alberta (Sheep Mountain, Waterton Lake, 28–31 Jul 1895, *Macoun* 11,889, ND-Greene); Ariz., Calif., Idaho, Mont., Nev., Wyo. Map 4.

The assertion that introgression has occurred between *Erythranthe tilingii* and *E. guttata* (Lindsay & Vickery 1967) is based on observations from northern Utah. Plants of the putative introgressants, from "the subalpine population from the Big Cottonwood Canyon," were noted by Lindsay and Vickery (1967, p. 453) as "typical of *M. guttatus* for the presence of underground stems which appears to be a residual *M. tilingii* trait from an ancient hybridization." In the UT herbarium, I identified a voucher as a plant of *E. utahensis*, for which  $2n = 30$  and prolific rhizome production is characteristic. Utah, Utah Co.: Mount Timpanogos, 7800 ft, 6 Aug 1956, *Wiens s.n.*,  $n = 15$  (UT), see Mukherjee and Vickery (1962). Also reported McArthur et al. (1972) as  $n = 15$  for *E. tilingii* in Utah Co. are these (vouchers not seen): Mt. Timpanogos Trail, 2650 m, 1968, Vickery cult. 7714; Mt. Timpanogos Trail, 2745 m, 1968, Vickery cult. 7717; Emerald Lake, 3050 m, Vickery cult. 7716.

*Erythranthe tilingii* has generally been regarded as a widespread species of relatively high elevations, the plants arising from a system of thin rhizomes and producing mostly 1–3 large flowers per stem. It is sometimes considered to include one or several infraspecific entities. The present study divides this "complex" into four distinct entities, without unambiguous intergrades, each of which is treated at specific rank. One other species, *E. utahensis*, also is included — it has not previously been associated with this group of species.

(1) *Erythranthe tilingii* sensu stricto is relatively widespread over the western USA and is sympatric with *E. corallina* and *E. caespitosa*. Leaves are variable in size in *E. tilingii*, and particularly in Idaho

they may approach the small size of those of *E. caespitosa* but the leaf margins of *E. tilmgii* are distinctly toothed and the stems are taller and more erect. Across the range of the species, plants sometimes produce very large leaves but these often can be seen to occur on plants with characteristically smaller leaves. This wide variability in size apparently does not occur in *M. caespitosus*.

(2) *Erythranthe minor* is characterized by very short corollas with relatively narrowly expanded limbs. Corollas of *E. tilmgii* rarely may be equally as short but are produced on plants that are depauperate in other ways as well (e.g., Oregon, Klamath Co., *Epling 5555*, MO; Washington, Thurston Co., *Meyer 1590*, MO) — these scattered, small-flowered individuals are perhaps the reason Pennell regarded the range of *E. minor* to be wider than recognized here. The nodding calyces of *E. minor* also distinguish the species. Overall, the distinction of *E. minor* appears to be subtle but real, especially in view of its geographic coherence.

(3) *Erythranthe caespitosa* is endemic to northwestern and central Washington and the Selkirk Range of British Columbia — the plants have consistently small leaves with subentire margins and the stems are consistently procumbent to decumbent-ascending, usually forming matted colonies. *Erythranthe caespitosa* and *E. tilmgii* apparently are sympatric in counties of northwestern Washington.

(4) *Erythranthe corallina* has hirsutulous to softly hirsute leaf surfaces and occurs only in the Sierra Nevada of California and adjacent Nevada (Washoe Co. and Carson City). Its chromosome number is reported as  $2n = 48$  and  $56$ , compared to  $2n = 28$  and  $56$  in *E. tilmgii*. Compared to *E. tilmgii* sensu stricto, the leaf blades of *E. corallina* are relatively broader, the shape broadly ovate to orbicular-ovate, the plants are generally taller, and long-pedicellate flowers occasionally are produced from midstem or even proximal nodes. The hirsutulous to hirsute vestiture of eglandular hairs on both leaf surfaces is a reliably diagnostic feature and usually easily observed with a lens.

7. **ERYTHRANTHE CAESPITOSA** (Greene) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus caespitosus* (Greene) Greene, J. Bot. (Brit. & Foreign) 33: 8. 1895. *Mimulus tilmgii* var. *caespitosus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 154. 1924. *Mimulus scouleri* var. *caespitosus* Greene, Pittonia 2: 22. 1889. **LECTOTYPE** (designated here): USA. Washington. [Pierce Co.]; Lake Shore, on Mt. Rainier, 20 Aug 1889, *E.L. Greene s.n.* (ND-Greene 046468 photo-PH!, photo-UT!; isoelectotypes: DS digital image!, ND-Greene-2 sheets!, NY digital image, PH!, UC! [with "TYPE" handwritten], US digital image!, WTU). Treated as a distinct species by Pennell (1951). When Greene raised this entity to specific rank in *Mimulus*, he intended only to reflect its disconnection from *M. scouleri* — he did not mention a relationship or similarity with *M. tilmgii*.

**Perennials**, with slender rhizomes. **Stems** delicate, 3–10 cm, glabrous, minutely hirtellous, or stipitate-glandular, usually in masses, terete or flattish, decumbent at base, rooting at the lower nodes sometimes producing creeping, small-leaved runners. **Leaves**: blades orbicular to narrowly elliptic or ovate, 5–12 mm long, becoming larger distally, palmately 3-veined, often purple beneath, sparsely to moderately puberulent with minute stipitate-glandular hairs, margins denticulate to entire, apex obtuse, base cuneate to a short petiole, proximal leaves usually sublyrate, distal sessile to subsessile. **Flowers** 1–3, commonly solitary. **Fruiting pedicels** 10–30(–40) mm, sparsely to moderately villous with short, gland-tipped hairs, sometimes with an admixture of hirtellous hairs. **Fruiting calyces** broadly campanulate, 7–15 mm, closing, the short lobes obtuse to acute or mucronulate, lower pair upcurved, uppermost 3–5 mm and prominently protruding. **Corollas** yellow, dark red-spotted, tube-throats broadly funnellform to cylindric-funnelform, 15–18 mm, palate partially closed, lower lip deflexed-spreading lobes, upper lip with ascending lobes. **Styles** minutely hirtellous.



**Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 4–5 mm, stipitate, included.

Flowering Jul–Sep. Alpine meadows and slopes, stream banks, wet rocks in streams, wet crevices, talus; 1100–2000(–2300) m. British Columbia (Selkirk Mts., Chilliwack Valley); Washington (Cascade and Olympic Mts.). Map 5.

8. **ERYTHRANTHE MINOR** (A. Nelson) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus minor* A. Nelson, Proc. Biol. Soc. Wash. 17: 178. 1904. *Mimulus langsdorffii* var. *minor* (A. Nelson) Cockerell in Daniel, Fl. Boulder, Colorado, 213. 1911. **TYPE: USA, Colorado.** [Boulder Co.:] Arapahoe Pass (near Boulder), timberline, 1904, *D.M. Andrews* 8 (holotype: RM fide Grant 1924, photo-PH!). Treated by Pennell (1951) as a distinct species occurring in the Hudsonian Zone from Oregon and Idaho south to Utah and New Mexico.

*Mimulus luteus* var. *alpinus* A. Gray, Proc. Acad. Philadelphia 15: 71. 1863 (non Lindley 1827). *Mimulus alpinus* (A. Gray) Piper, Contrib. U.S. Natl. Herb. 11: 510. 1906. *Mimulus langsdorffii* var. *alpinus* (A. Gray) Piper, Mazama 2: 99. 1901. *Mimulus langsdorffii* var. *alpinus* (A. Gray) Blankinship, Montana Agric. College Sci. Bull. 1: 98. 1905. **TYPE: USA, Colorado Territory.** Alpine and subalpine, 39–41°N, 1862, *C.C. Parry 135a* (holotype: GH photo-PH!). The protologue entry: "caulibus 3-pollicaribus e basi decumbente vel repente 1-3-floris; foliis plerisque sessilibus subintegerrimis. Alpine region, 135a coll. Parry, 1862. Very glabrous." The PH photo has a label of *Parry 235a*, 1862.

**Perennial**, rhizomatous. **Stems, pedicels, and calyces** densely minutely hirtellous and eglandular or with a mixture of hirtellous and gland-tipped hairs. **Stems** erect to erect-ascending, 5–20 cm. **Leaves:** blades broadly ovate to elliptic-ovate or lanceolate, 8–25 × 5–15 mm, palmately 3-veined, both surfaces glabrous, margins shallowly dentate to denticulate, apex acute to obtuse, base cuneate to truncate, sessile to subsessile or proximal with petioles 1–3 mm. **Flowers** 1–3, from distal nodes. **Fruiting pedicels** 10–20 mm. **Fruiting calyces** 10–13 mm, closing, nodding 80°–100°, without purple dots. **Corollas** yellow, apparently without red dots, tube-throats tubular-funnelform, 9–11 mm, exserted from the calyx 0–1(–2) mm. **Styles** sparsely hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 5–8 mm, stipitate, included.

Flowering Jul–Aug(–Sep). Stream edges, lake edges, intermittent water courses, subalpine rill, roadside ditches, subalpine to alpine; 3000–3700 m; Colorado, New Mexico, Utah. Map 6.

The corollas of *Erythranthe minor* are distinctly shorter than those of typical *E. tilingii* and the geographic range of the species is set apart from *E. tilingii*. The morphological difference between the two is especially apparent by comparison of a set of specimens of one with the other. The range of *E. minor* is primarily in Colorado apparently extends into Utah (La Sal Mountains of Grand and San Juan counties) and into New Mexico (the Wheeler Peak area of Taos County).

The only collection seen from New Mexico is this: Taos Co.: Carson Natl. Forest, 8 mi from Red River town, bank of Goose Lake, 11,650 ft, 23 Aug 1968, *Correll & Correll 36261* (NMC).

9. **ERYTHRANTHE CORALLINA** (Greene) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus corallinus* Greene, Erythra 4: 21. 1896. *Mimulus tilingii* var. *corallinus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 155. 1924. **TYPE: USA, California.** [Nevada Co.:] Washoe Mts., [protologue: "Plentiful along the western base of the Washoe Mountains beyond Truckee,"] 25 Jul 1895, *E.L. Greene s.n.* (holotype: ND-Greene, photo-UT!; isotype, as labeled: NY digital image!). The protologue (p. 21) noted "Plentiful along the western base of the Washoe Mountains beyond Truckee, but also near Summit Station, from the latter district it has been distributed by me under the name of *M. tilingii*." Pennell (by annotation) identified this as *Mimulus tilingii*.

*Mimulus minusculus* Greene, Leafl. Bot. Observ. Crit. 2: 5. 1909. TYPE: USA. California. [Tulare Co.:] South Fork of Kern River, 8200 ft, 1875, J.T. Rothrock 312 (holotype: US fide Greene in the protologue, but not included in US type database). Greene noted that "the whole plant is sparsely and minutely hispid-hirtellous."

**Perennials**, prolifically rhizomatous, rhizomes thin. **Stems** mostly erect to ascending-erect, 6–25(–38) cm, moderately hirsute to hirsutulous with deflexed hairs. **Leaves** basal and cauline, becoming larger distally or even-sized, blades ovate to broadly ovate, 15–45 mm, palmately 5-veined, hirsutulous on both surfaces with ascending hairs, eglandular, margins sharply dentate-serrate, apex obtuse, base mostly truncate to shallowly cordate, sessile or subsessile or proximal with petioles 1–15 mm. **Flowers** 1–3(–6), commonly solitary or mostly from distal nodes. **Fruiting pedicels** (10–)25–75 mm, glabrous or puberulent proximally with stipitate-glandular hairs. **Fruiting calyces** broadly cylindric-campanulate, 11–15 mm, not closing, sometimes purple-spotted, lobes shallowly deltate, lower pair slightly upcurved. **Corollas** yellow, red-spotted, tube-throats narrowly funnelliform to broadly cylindric, 13–20 mm, limb expanded 12–22 mm (pressed). **Styles** sparsely hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 7–10 mm, stipitate, included.  $2n = 48, 56?$

**Flowering** (May–)Jun–Aug. Creek banks, moraine water courses, bogs, marshes, wet meadows, roadside ditches; 4800–)5700–9000(–10,000) ft; California, Nevada. Map 7.

Before learning that *Erythranthe corallina* is the correct name for this species, I annotated various collections of it as *Erythranthe minuscula*.

For *Erythranthe corallina*, Vickery made chromosome counts of  $2n = 48$  from Tuolumne Co. (Porcupine Flats, 8000 ft, 17 Sep 1958, *Heisey 576* (UC, UT) and  $2n = 56$  from El Dorado Co. (8 mi from Calif. checking station along US Hwy 89, 7200 ft, summer 1963, *Wilson s.n.* (UT), identifying the vouchers as *Mimulus tilingii* var. *corallinus*. How the  $2n = 48$  population might have arisen in *E. corallina* is obscure, since its putative relatives apparently are  $2n = 28$  and  $2n = 30$ . The species appears to be relatively uniform and it seems likely that it had but a single evolutionary origin. The voucher for the count of  $2n = 56$  needs to be reexamined on the possibility that it may be *E. utahensis*, and the count of  $2n = 48$  needs to be verified.

Two collections from the southern part of the range are of very low plants with decumbent-ascending stems (4–10 cm) and tiny ovate-triangular leaves (blades 5–10 mm  $\times$  3–6 mm) but the dense system of filiform rhizomes, flowers 1–3, and hirtellous foliar vestiture identify them as *Erythranthe corallina*. San Bernardino Co.: San Bernardino Mts., Bluff Lake, 7400 ft, 21–27 Jun 1895, *Parish 3606* (JEPS); eastern San Gabriel Hills, Lost Creek, W-facing canyon, on W-facing wet cliff face, 6800 ft, 22 Jul 1994, *Swinney 3088* (DAV). Other collections of *E. corallina* from Bluff Lake are typical in habit (e.g., *Clokey 5301* and *5305*, UC; *Grinnell 80*, UC) and similar compaction of the basal parts occurs sporadically elsewhere in the range of the species as well as in *E. tilingii*.

10. **ERYTHRANTHE UTAHENSIS** (Pennell) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus glabratus* subsp. *utahensis* Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1: 123, map 23. 1935. TYPE: USA. Utah. Millard Co.: along brook, Preuss Lake, near Clay's Ranch, 29 Aug 1919, *I. Tidestrom 11180* (holotype: PH!).

**Perennial**, prolifically rhizomatous, thin rhizomes. **Stems** erect or proximally decumbent-ascending and rooting at the nodes, 20–50 cm, glabrous or sparsely stipitate-glandular in the inflorescence. **Leaves** basal and cauline, even-sized or largest near midstem, sessile to subsessile except for proximal-most, blades orbicular or suborbicular to broadly elliptic, broadly ovate, or depressed ovate, 20–40(–75) mm  $\times$  12–35(–40) mm, both surfaces glabrous to glabrate or commonly

sparsely stipitate-glandular and sparsely pilose with thin-walled hairs, often glaucous abaxially, margins entire or subentire to mucronulate or shallowly dentate or denticulate, apex rounded, base usually truncate to broadly cuneate; petioles absent or 2–10 mm. **Flowers** 6–16 in a loose raceme, distal bracts becoming much reduced. **Fruiting pedicels** (25–)40–75 mm, straight, stipitate-glandular to short villous with gland-tipped hairs. **Fruiting calyces** (10–)11–17(–20) mm, not closing, lobes convex-mucronulate, upper lobe slightly longer and triangular-blunt, stipitate-glandular or minutely hirtellous or a mixture, sometimes also with longer, thin-walled eglandular or glandular hairs. **Corollas** yellow, lower lip prominently darker yellow and sparsely purple-spotted, tube-throats narrowly funnelliform to broadly cylindric, 10–15 mm, exerted 5–8 mm beyond calyx margin, limb weakly bilabiate, expanded 12–20 mm (pressed). **Styles** hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 5–8 mm, stipitate, included.  $2n = 28, 30$ .

Vouchers at UT for chromosome counts by Vickery:  $2n = 28$  (California, Mono Co.; Nevada, Mineral Co.; Utah, Juab Co.);  $2n = 30$  (Nevada, Elko Co. and White Pine Co.; Utah, Tooele Co. and Wayne Co.).

Flowering (Feb–)May–Aug(–Oct). Drainage ditches, springs, seeps, wet meadows, margins of ponds and small streams, marshy areas; 1400–2500 m; California (Fresno, Mono, Tuolumne), Colorado, Nevada, Utah. Map 7.

Colorado records as mapped from Delta, Montrose, and Saguache counties are from the database of collections from CU Museum-COLO (2009); collections from Montrose Co. were cited for subsp. *utahensis* by Pennell. California records for Fresno, Mono, and Tuolumne counties are vouchered by these: Fresno Co.: 6500 ft, 8 Jul 1949, *Bean 516*, Vickery cult. 5047 (UT). Mono Co.: Mono Lake, Rush Creek, 4 Sep 1948, *Mason 13646* (UC); by Mono Lake, 6440 ft, Jul 1948, *Stebbins 714* (UC). Tuolumne Co.: near the middle Fork of the Tuolumne River, 6000 ft, *Stebbins s.n.*, Vickery cult. 5047 (UT).

*Erythranthe utahensis* was treated as a distinct entity (as *Mimulus glabratus* subsp. *utahensis*) by Welsh et al. (2003). Holmgren (1983, p. 354) noted that "Subspecies *utahensis* Pennell is easily distinguished from the other subspecies of *M. glabratus*, but it can be too easily accommodated within the broad range of variability of *M. guttatus* DC." — he cited collections from Pennell's original documentation in recognizing at least the potential existence of subsp. *utahensis*. *Mimulus glabratus* subsp. *utahensis* was placed without comment as synonym of *M. guttatus* by Thompson (1993).

*Erythranthe utahensis* is characterized by its erect stems, prolifically produced filiform rhizomes, basal leaves short-petiolate to subsessile and cauline sessile, blades suborbicular to broadly ovate or depressed ovate with thin-walled villous-glandular hairs on both surfaces, margins subentire, proximal pedicels elongating to 75 mm, and calyces open at maturity. The species most closely similar to *E. utahensis* is *E. corallina* — both species have a dense system of thin rhizomes, thin and suborbicular leaf blades, long pedicels, open calyces, and large corollas. The two are sympatric where *E. utahensis* apparently touches into the Sierra Nevada of California. Plants of one collection have the taller habit of *E. utahensis* but with fewer flowers as in *E. corallina* and an apparently intermediate vestiture: Tuolumne Co.: Ackerson Creek, 4710 ft, 26 Aug 1949, *Vickery 191* (UT). The two species are distinguished by the following contrasts.

- |  |                              |
|--|------------------------------|
| 1. Flowers 1–6, from distal nodes only; corolla tubes 14–20 mm; fruiting pedicels 15–75 mm long; stems 6–25(–38) cm; leaf blades prominently dentate with sharp teeth, hairs of surfaces short, sharp-pointed, eglandular, thick-walled, and dull gray ..... | <i>Erythranthe corallina</i> |
| 1. Flowers 6–16, from proximal to distal nodes; corolla tubes 10–13 mm; fruiting pedicels (25–)40–75 mm; stems 20–50 cm, leaf blades subentire to shallowly dentate, hairs of surfaces longer, apically blunt, gland-tipped, thin-walled and vitreous .....  | <i>Erythranthe utahensis</i> |

*Erythranthe utahensis* previously has been regarded as a member of the '*Mimulus glabratus* complex' because of its similar chromosome number and presumably because of its calyx, which usually remains open at maturity. The distinctive rhizome system, however, as well as its foliar vestiture and its western USA geography, indicate that it belongs with the *E. tilingii* group. The allozyme analysis by Vickery (1990) places *Erythranthe utahensis* as more similar to Andean groups with  $n = 46$  than to any other North American groups previously identified as *E. glabrata*, but the analysis did not include any other species of the *E. tilingii* group.

11. **ERYTHRANTHE GUTTATA** (Fischer ex DC.) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus guttatus* Fischer ex DC., Cat. Pl. Horti Monsp., 127. 1813. *Mimulus langsdorffii* var. *guttatus* (Fischer ex DC.) Jepson, Fl. W. Mid. Calif., 406. 1901. **TYPE MATERIAL:** USA, Alaska. No other data, ca. 1803-1805, *G.H. Langsdorff s.n.* (CGE?; LE fide Tokarska-Guzik and Dajdok 2010; NY fide Pennell 1935). Figure 1.

The 1813 protologue is reproduced here:

"(141) **MIMULUS GUTTATUS**. M. foliis ovatis multinerviis denticulatis, inferioribus petiolatis, caulibus basi repentibus ascendentibus pilosiusculis projectura foliorum subtetragonis, pedicellis folio florali brevioribus. DC. hort monsp. med. t. 60.

Hab. .... Species affinis M. luteo cujus icon adest in *Fauell. peruv.*, sed differt: 1.° caule petiolique pilosis nec laevibus; 2.° foliis inferioribus longe petiolatis nec subsessilibus; 3.° dentibus foliorum inaequalibus nec regularibus; 4.° pedicellis folio brevioribus nec duplo longioribus; 5.° flore fere duplo minore; 6.° fauce piloso nec ut in icone Fawilleana glabro."

As a synonym of *Mimulus luteus* L., Bentham (1846, p. 370) listed "M. guttatus DC! cat. hort. monsp. p. 127" and also cited the discussion and illustration of Langsdorff's *Mimulus* (see notes below for *M. langsdorffii* J. Donn ex Greene 1895). Gray (Synopt. Fl., p. 448) also regarded the South American and western North American plants as conspecific, as *M. luteus*.

Grant (1924) did not specify a type for *M. guttatus*. Pennell (1935) noted that "Quite certainly the seeds of these garden plants were obtained from the same source as those of the plant figured in the Botanical Magazine 36: t. 1501. 1812 as *M. luteus*, being from Langsdorff who collected the plant, between 1806 and 1810, on Unalaska, one of the Fox Islands, Alaska. A probable duplicate of Langsdorff's specimen, or else its progeny in a Russian garden, as in Herb. New York Botanical Garden, labeled *Mimulus guttatus* F. Unalaschka. Fishcher." Pennell (1947) and Campbell (1950) essentially repeated Pennell's earlier account of the provenance.

The nature of Pennell's "certainty" about the source of the seeds is at least ambiguous, but he perhaps assumed that it was no coincidence that the Montpellier garden catalog and the Botanical Magazine article were published at essentially the same time and that Russian botanist F.E.L. Fischer also had access to the gatherings of Langsdorff. The plant illustrated in the Botanical Magazine of 1812 was said to be grown from seeds collected in Alaska by Langsdorff and initially sent to John Hunneman in England in about 1811. Tokarska-Guzik and Dajdok (2010) observed that Langsdorff collected the seeds during his voyage in 1805 to Marquis Island (1804-1808).

*Mimulus rivularis* Nutt., J. Philadelphia Acad. Nat. Sci. 7: 47. 1834. **TYPE:** USA, Idaho or Oregon. Head of Colum[bia River], [probably 1832], *N.J. Wyeth s.n.* (holotype: PH; holotype isotype: MO! see comments below). Protologue: "Stoloniferous; very smooth. Root leaves round oval, sharply crenate, petiolate, stem leaves similar, sessile. Flowers large, bright yellow. *Hab.* In the valleys of the Rocky Mountains."

The PH sheet hold four branches, all of which were identified by Pennell (by annotation) first as *Mimulus guttatus* and then as *M. puberulus*. Grant (1924) also apparently regarded all as equally pertinent to the type concept. Two separate collections and two separate labels, however, are mounted and the collections are not of the same entity.

The one longer and thicker stem has pedicels and calyces sparsely villous with gland-tipped hairs — it matches Nuttall's protologue and is the actual type. Immediately below this

branch is mounted a small handwritten label (by Nuttall): "*Mimulus luteus rivularis*, Head of Colum. (Nutt ?? Wyeth)."

The three shorter and relatively thin stems have pedicels densely hirsutulous mixed with a few gland-tipped hairs. The accompanying label has a printed header: "US Geological and Geographical Survey of the Territories, SECOND DIVISION. J.W. Powell, in charge" with collection data as "Utah. [Sevier Co.]; Glenwood, 23 May 1875, L.F. Ward 90."

The collection at MO is labeled L.F. Ward 90, but it closely matches the morphology of the PH Nuttall collection — not those from Utah on the PH sheet — and it seems probable that the MO label was distributed with the wrong collection of plants. The MO sheet probably is part of the Wyeth-Nuttall collection and, if so, is thus an isotype.

*Mimulus lyratus* Benth., Scroph. Indicae, 28. 1835. *Mimulus guttatus* var. *lyratus* (Benth.) Pennell ex Peck, Man. Pl. Oregon, 654. 1941. TYPE: USA. California. The protologue notes only "California, Douglas" (holotype: K photo-MO!).

*Mimulus glabratus* var. *adscendens* A. Gray, Synopt. Fl. N. Am. ed. 2, 2, Suppl. 448. 1886. TYPE: USA. Arizona. [Coconino Co.]; Grand Canyon of the Colorado, 4 May 1885, A. Gray s.n. (holotype: GH photo-PH!). Protologue: "A large and robust form (as sometimes in Mexico), rising a foot or two high from the creeping base; branches freely racemously flowered at summit; the upper and sometimes connate rounded leaves being much reduced and bracteiform. — *M. glabratus* (chiefly), Gray, Bot. Mex. Bound. 116. *M. hallii*, Greene, Bull. Calif. Acad. 113, but species not truly annual, nor calyx-teeth acute. The specimen of Hall described from [sic] was a cultivated one — Colorado and west to the Grand Cañon in N.W. Arizona, south to Mexico." \*Hirtellous vestiture, eglandular.

*Mimulus langsdorffii* var. *argutus* Greene, J. Bot. (Brit. & For.) 33: 7. 1895. TYPE: USA. Alaska. The protologue cited "Sitka, Barclay; also Oregon, Tolmie, Nuttall, and others."

*Mimulus langsdorffii* var. *platyphyllus* Greene, J. Bot. 33: 7. 1895. TYPE: CANADA. British Columbia. Near Vancouver. "Collected long ago, on the shores of Nutka Sound, by Barclay."

*Mimulus langsdorffii* J. Donn ex Greene, J. Bot. (Brit. & Foreign) 33: 6. 1895. TYPE: USA. Alaska. ca. 1803-1805 or 1804-1808, G.H. Langsdorff s.n. (holotype: CGE?). Homotypic with *Mimulus guttatus*. Greene (1895) noted that "*M. langsdorffii* is an older name than *M. guttatus* for the North American type of this group," but Donn (J. Donn ex Sims, Bot. Mag. 36: sub pl. 1501. 1812) referred to the plant as "Langsdorff's *Mimulus*" — identifying it as *M. luteus* of Linnaeus, thus not validating a new epithet. Greene in 1895 attributed the earlier publication to "Donn in Sims."

As written by Sims in the protologue: "This beautiful species of *MIMULUS* was found by Dr. LANGSDORFF, who was attached, as naturalist, to the Russian embassy to China. He brought it, as we are informed, from Unashka, one of the Fox Islands, and seeds were transmitted to Mr. HUNNEMANN last spring, and through him to Mr. DONN, curator of the Botanical Garden at Cambridge, who kindly communicated to us in July last the specimen from which our drawing was made, under the name of *MIMULUS Langsdorffii*, which we should have adopted, had it proved, as was supposed, a new discovery. But the same species was found in Chili, by Father FEUILLEE, and has been long ago described and figured in his work, as above quoted. From him LINNAEUS inserted it in his Species Plantarum, with the specific name of *luteus*. It was found also in California and at Nootka, by Mr. ARCHIBALD MENZIES."

*Mimulus grandiflorus* J.T. Howell, Fl. N.W. Amer. 5: 520. 1901. TYPE: USA. Oregon. [Clackamas Co.]; Wet places along the Tualatin River near its mouth, Jul 1900, T. Howell s.n. (holotype: ORE digital image! photo-PH!). No type was cited, the protologue giving only this: "Growing in wet places along streams, western Oregon and Washington: beginning to flower early in May." Described as "stolons; stems 1-4 feet high; lower leaves sublyrate; calyx red-

- dotted, closed; infl. sparsely hairy; corolla 2 inches [5 cm]." The ORE[OSC] sheet has "Type specimen" handwritten on the label.
- Mimulus hirsutus* J.T. Howell, Fl. N.W. Amer. 5: 520. 1901 [non Blume 1826]. TYPE: USA. Oregon. [Clackamas Co.:] In the Tualitin River near its mouth, Jul 1900, T. Howell s.n. (holotype: ORE digital image!). No type was cited, the protologue giving only this: On wet rocks in the Tualitin and Willamette rivers Oregon: beginning to flower about the first of July." Described as 'stems stoutish, 1-2 feet high, stolons; calyx red-dotted, closed; lower leaves often laciniately lobed or lyrate; infl. hirsute; corolla 1 inch." The ORE[OSC] sheet has "Type specimen" handwritten on the original label and has been annotated later as "holotype."
- Mimulus prionophyllus* Greene, Leaf. Bot. Observ. Crit. 1: 190. 1905. TYPE: USA. Arizona. [Coconino Co.:] Willow Spring, 10 Jun 1890, E. Palmer 527 (holotype: US digital image! photo-PH! photo-UC!).
- Mimulus paniculatus* Greene, Leaflets Bot. Observ. Crit. 1: 190. 1906. TYPE: USA. California. San Diego Co.: Witch Creek, May 1894, R.D. Alderson s.n. (holotype: ND-Greenel, photo-PH!, photo-UT!). The plant has fistulose stems like *M. petiolaris*.
- Mimulus puberulus* Greene ex Rydberg, Fl. Colorado, 311. 1906 [Greene, Leaf. Bot. Observ. Crit. 2: 4. 1909]. *Mimulus guttatus* var. *puberulus* (Greene ex Rydberg) A.L. Grant, Ann. Missouri Bot. Gard. 11: 170. 1924. LECTOTYPE (designated here): USA. Colorado. [Archuleta Co.:] Pagosa Springs, 27 Jul 1899, C.F. Baker 587 (ND-Greene 046404!, photo-UT!; isocototypes: F digital image!, MO! digital image!, ND-Greenel, NY digital image! photo-PH!; POM, RM, UC!, US digital image!). Greene (1909) cited Baker 587, "in my own herbarium," as the type. Grant (1924) referred to the name as published by Rydberg as a "nom. nud." and Rydberg apparently did not intend to publish the name as an innovation, perhaps assuming that Greene had already published it, but his key to species provides a morphological diagnosis. Rydberg's use of the name in 1906 can be taken as a valid publication.
- Mimulus equinus* Greene, Leaf. Bot. Observ. Crit. 1: 189. 1906. TYPE: USA. California. Lake Co.: In the "Horse Pasture," near the summit of Mt. Sanhedrin, 20 Jul 1902, A.A. Heller 5924 (holotype: US digital image!; isotypes: CAS digital image!, NY digital image!, PH!).
- Grant (1924) treated *Mimulus equinus* as a variety of *M. guttatus* (as *M. guttatus* var. *puberulus*), noting that it was distributed "in wet places in southern Colorado and northern New Mexico," and characterized by "stems densely pubescent above, often freely branched from the base; leaves puberulent or pubescent, usually grayish-green; pedicels shorter than the flowers, sometimes recurved in fruit; and corolla 2-3 cm. long." Pennell (1947, p. 166) noted that it "does not seem to me actually distinguishable from the common plant so widespread through the Rocky Mountain and Intermontane states, a plant distinguishable from true *M. guttatus* by its habitually smaller flowers. Were one to consider the two as separate species there are a number of names available for the common plant of the western United States, but as a subspecies the earliest trinomial is *puberulus*, which Dr. Grant intended to apply only to its pubescent extreme." \*Hirtellous vestiture, eglandular.
- Mimulus clementinus* Greene, Leaf. Bot. Observ. Crit. 2: 5. 1909. TYPE: USA. California. [Los Angeles Co.:] San Clemente Island, off the coast of southern California, Jun 1903, B. Trask s.n. (holotype: US digital image! photo-PH!; isotype: NY digital image!).
- Mimulus petiolaris* Greene, Leaf. Bot. Observ. Crit. 2: 7. 1909. TYPE: USA. California. [Inyo Co.:] Argus Mountains, Shepherd Cañon, 800-2000 m, 28 Apr 1891, F.V. Coville 740 with F. Funston (holotype: US digital image! photo-PH!; isotypes: MO!, NY digital image!, PH!).
- Mimulus langsdorffii* var. *minimus* J.K. Henry, Fl. S. Brit. Columbia, 268. 1915. TYPE: CANADA. British Columbia. Paisley Island, near Vancouver. The protologue: "Glabrous, stems 6-10 cm. high, corolla [20-40 mm] with one very large, light brown-purple spot on the lower lip. Paisley Island."

*Mimulus guttatus* subsp. *haidensis* Calder & Taylor, Canad. J. Bot. 43: 1398. 1965. TYPE: CANADA. British Columbia. Queen Charlotte Islands, Moresby Island, about 3 mi W of head of Cumshewa Inlet below north face of the Mt. Moresby, common along rocky-gravelly margins of steep facing funnel between 700 and 1300 ft, 31 July 1964, J.A. Calder & R.L. Taylor 36391 (holotype: DAO; isotype: NY digital image!).

A collection identified and distributed as *Mimulus guttatus* subsp. *haidensis* is this: Queen Charlotte Islands, [Moresby Island,] ca. 20 mi S of Moresby Logging Camp, 29 Jul-2 Aug 1957, Calder, Saville, and Taylor 23063 (UC!). Stems, pedicels, and calyces minutely hirtellous, eglandular.

Perennial, rhizomatous; stems, pedicels, and calyces villous-glandular or moderately to densely hirtellous with eglandular hairs or with a combination of glandular and eglandular hairs. Stems erect to ascending-erect, (6-)15-65(-80) cm, sometimes fistulose (up to 10 mm wide, pressed), sometimes rooting at proximal nodes. Leaves basal and cauline or basal absent at flowering, palmately or usually subpinnately 5-7-veined, proximal long-petiolate, blades 4-125 mm, ovate-elliptic to ovate or suborbicular, gradually or abruptly reduced in size distally, margins crenate to coarsely dentate, proximally shallowly toothed to irregularly small-lobed or lyrate-dissected, apices rounded to obtuse, bases rounded to cuneate to truncate, petioles absent or 1-95 mm. Flowers (1-)3-20(-28), mostly from distal nodes, sometimes in relatively compact racemes with reduced bracts. Fruiting pedicels 15-40(-60) mm. Fruiting calyces ovate-campanulate, 11-17(-20) mm, closing, nodding, usually without red markings. Corollas yellow, red-dotted, tube-throats infundibular, (10-)12-20 mm, exerted 3-5 mm beyond the calyx margin, limb bilabiate, expanded 12-24(-24) mm (pressed). Styles minutely hirsutulous to villousulous. Herkogamous; anther pairs at different levels, stigma above upper anther pair. Capsules 7-11(-12) mm, stipitate (stipes 1-1.5 mm), included.  $2n = 28, 56$ .

Flowering Apr-Sep. Springs and seeps, marshes, beaver dams, along rivers, streams, and irrigation canals, loamy soil in conifer forest, wet and damp meadows, wet roadsides; 20-3200(-3700) m; British Columbia, Saskatchewan (Cypress Hills), Alberta (Cypress Hills); Alaska, Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, Oregon, New Mexico, South Dakota, Texas, Washington, Wyoming; Mexico (Baja California, Chihuahua, Coahuila, Sonora); introduced in ne USA (Connecticut) and e Canada. Introduced in Europe (the introduction and spread of *Erythranthe guttata* in Europe is documented in detail by Tokarska-Guzik and Dajdok 2010). Map 9.

An eastern outlier of *Erythranthe guttata*: Nebraska. Keith Co.; 2 mi W of Lemoyne, N side of Lake McConaughy, swampy springy flat along prairie creek, sandy soil, 11 Jun 1967, Stephens 11540 (SMU). The leaf shape is suggestive of *E. geyeri* but the plants are erect and the corollas are relatively large (tubes 13-15 mm) with the stigma 2 mm above the longest anther pair.

A single collection is known from Texas: Presidio Co.; Chinati Mountains State Natural Area, Pelillos Canyon, at fork of Tinaja Prieta Canyon, riparian vegetation, in igneous gravel and bedrock, 4047 ft, 18 Sep 2004, Lott et al. 5343 (TEX).

Even as more narrowly defined in the present study, *Erythranthe guttata* is markedly variable in morphology — particularly in stature, leaf shape, vestiture, flower size, and the distance of separation between anthers and stigma, and it ranges from subalpine and near-alpine habitats into desert situations where water is available. It seems probable that further study will distinguish distinct variants.

Sweigart and Willis (2003) found that nuclear DNA variation within populations of *Erythranthe guttata* (including *E. microphylla* in their concept) is exceptionally high compared to *E. nasuta*, where sequence similarity is high among (vs. within) populations.

### Morphological variants.

Plants of *Erythranthe guttata* with extremely large corollas have been abundantly collected on the Aleutian Islands and Kokiak Island as well as in other Alaskan localities (e.g., Juneau, Amakuk, Yakutat Bay, Admiralty Island). Corolla tubes are 19–26 mm long and the limbs are expanded to 18–25 mm (pressed). The type collection by Langsdorff is one of these plants, as is the plant of *Mimulus langsdorffii* illustrated in the 1812 Botanical Magazine (Fig. 1). The plants are glabrous and relatively low in stature and perhaps represent an extreme in a continuum of variability, but patterns of variation in the species need to be investigated in detail (see further comments below under "Reported variation in ploidy level." The name *Erythranthe guttata* may prove to apply most appropriately only to Alaskan populations. Vickery et al. (1968) also observed that the tetraploid appeared to match the type of the species, based on their study of a "photograph of the De Candolle herbarium specimen of *M. guttatus*." A diploid also has been reported from the Aleutian Islands (see notes below), thus it appears that diploids and tetraploids may be sympatric in this area.

In scattered localities in California, both arid and more mesic, plants of *Erythranthe guttata* may become extremely tall (over 1 meter) with greatly expanded, fistulose stems and correspondingly large leaves (the type of *Mimulus petiolaris*, from Inyo Co., is like this) and similar plants have been collected in other states). Despite their striking appearance and a suspicion that such plants might be polyploid, their scattered and relatively common occurrence suggests that they are phenotypic variants within the morphological range of the diploid species.

In the area of El Dorado and Placer counties, California, plants of *Erythranthe guttata* are consistently relatively small and are commonly collected without rhizomes. When rhizomes do show, they are filiform. Corollas of these plants are relatively short and appear to be whitish or pale yellow with a darker palate. Further study in field and lab presumably would show whether such plants represent a distinct race.

*Mimulus guttatus* subsp. *haudensis* was described as "an endemic subalpine race" that occurs in and along the flanks of the Queen Charlotte Ranges on Graham Island and Moresby Island. It was distinguished on the basis of its hirtellous vestiture, but plants of similar hirtellous vestiture occur over the whole range of the species. A tetraploid chromosome number ( $2n = 56$ ) was reported for subsp. *haudensis* from a total of five localities on Graham Island and Moresby Island (Calder & Mulligan 1968) and diploids ( $2n = 28$ ) were documented from one locality on each of the two islands. At least one of the diploids has densely hirtellous stems, pedicels, and calyces — matching the morphology of subsp. *haudensis*: **British Columbia**. Queen Charlotte Islands, Graham Island, outskirts of Queen Charlotte City, 13 Jul 1957, Calder et al. 22481 (MO, TEX). A duplicate of Calder et al. 22481 (UC) has a mix of hirtellous and glandular hairs. Calder et al. 36535 (UC) from Moresby Island has hirtellous pedicels but is otherwise completely glabrous. Without more documentation, the hypothesis that tetraploids represent a distinct morphological race in this area can be received only with low confidence.

Variation in vestiture does suggest, however, that regional differentiation has occurred within *Erythranthe guttata*. In all of Colorado, the Four Corners area, and north-central New Mexico, particularly, the vestiture of stems and calyces is consistently densely hirsute-hirtellous, without glandular hairs. Plants with similar vestiture also occur in Oregon, Washington, and British Columbia and in scattered localities elsewhere. In southern Oregon, California, and into Nevada and northwestern Arizona, vestiture is consistent in its villous-glandular nature, without eglandular hairs. Elsewhere in the geographic range the vestiture is a mix of hirsute-hirtellous (eglandular) and villous-glandular hairs. In this quick study, I have not been able to consistently correlate the pattern of vestiture with variation in other features.



The type of *Mimulus puberulus* Greene (Hinsdale Co., southern Colorado) has densely hirtellous-hirsutulous, eglandular vestiture on the stems, leaves, pedicels, and calyces and basal runners similar to the species in the rest of Colorado and northern New Mexico, but the plants produce relatively short corollas (but apparently herkogamous and allogamous) and the calyces have a relatively long upper lobe suggestive of *E. nasuta*. Plants of this region may come to be recognized as evolutionarily distinct, particularly if they should prove to be consistently tetraploid (see further comments below).

A collection similar to "*Mimulus puberulus*" also has been made from southeastern Arizona. These are small plants like those from northern New Mexico, with densely hirtellous-subvillosous vestiture, but the corollas are very short and appear to be autogamous (pleiogamous) though they have an expanded limb. Arizona. Greenlee Co.: Hannagan Meadow area, 8900-9300 ft, 21 Jun 1962, Schmidt 170 (ARIZ).

Lindsay and Vickery (1967) and Vickery et al. (1968) reported a chromosome count of  $2n = 30$  for a population of *Mimulus guttatus* from Cache Co., Utah ("Logan drainage," [Cache Valley,] Providence, 4500 ft, Vickery cult. 6177, UT), noting (1968, p. 213) that "the population is relatively uniform morphologically although its leaves are rounder and its calyces are blunter than is usual in *M. guttatus*. These traits suggest to us that this population may be showing the residual effects of previous introgression from *M. glabratus* var. *utahensis* Pennell." They also noted that because of pairing irregularities, the number might actually be  $2n = 28$  with a pair of B chromosomes. The voucher for the  $2n = 30$  count, however, seems better identified simply as *Erythranthe utahensis*. Claims by Vickery that hybridization and introgression also have occurred between *E. utahensis* and *E. guttata* in the Big Cottonwood and Provo drainages of Utah County are minimally and obliquely documented and need to be critically examined.

#### Reported variation in ploidy level.

Map 8 shows the USA localities of diploid and tetraploid chromosome numbers reported for plants identified as *Mimulus guttatus*. An account of most of the tetraploid counts is provided here.

\* Arizona (Cochise Co.: [Huachuca Mts.,] Ramsey Canyon, 1646 m, Vickery cult. 7558, voucher not seen. Yavapai Co.: Verde Valley, 3 mi S of Camp Verde, by larger of 2 springs along the cliffs on the E edge of the river at Ward Ranch, 3010 ft, no date, Vickery 2593, cult. 6250, UT-2 sheets, cult. 6290, UT; Mia et al. 1964 and Vickery et al. 1968). Figure 2 in Vickery et al. shows 14 loosely paired quadrivalents.

\* New Mexico (Grant Co.: Gila River, 4400 ft, Vickery cult. 6615, voucher not seen). The voucher for a tetraploid count of  $2n = 56$  from Catron Co. (Reserve, 5770 ft, Vickery & Tai 7, Vickery cult. 6613) is identified here as *Erythranthe cordata*, which otherwise is known as  $2n = 30$  from 6 separate counts. This count needs to be reassessed and is not mapped.

\* Arizona. Mohave Co. As reported by McArthur et al. (1972): " $n = 14$ , 28: Ariz., Mohave, Moccasin, 1525 m, 7555." No voucher was located at UT for this collection; see comments below for Kane Co., Utah.

\* Colorado (La Plata Co.: Bayfield, Los Pinos River, 6750 ft, Tai & Vickery 21, Vickery cult. 6627, UT) and New Mexico (Rio Arriba Co.: Rio Chama, near bridge along Hwy 84, between river gravel bars and river-worn rocks on bars by the river, 7500 ft, Tai & Vickery 16, Vickery cult. 6622, UT); Tai & Vickery 17 (cult. 6623, UT) was collected at the same locality; Tai & Vickery 18 (cult. 6624, UT) was collected from the same vicinity, "near bridge on gravel bars, 6900 ft." The chromosome counts are from adjacent counties and this is the immediate region of plants noted above as possibly

representing an entity evolutionarily distinct from *E. guttata* (see comments above regarding *E. puberula*).

\* **Colorado. Grand Co.:** Along the Rollins Pass road just above the Moffitt Tunnel, 10,000 ft, 1967, *Foreman s.n.*, McArthur cult. 7693-221 (UT). Another collection from Grand Co. is reported as diploid ( $2n = 28$ ): Little Yellowstone Canyon, Shadow Mt. area, 14.5 mi N of Grand Lake, gravel at streamside, 9560 ft, 10 Aug 1966, *Douglas 61-488*, Vickery cult. 7139 (UT). Plants of both collections both have densely hirtellous vestiture and are very similar in other respects as well. It is not unreasonable to suppose that this is an instance of autotetraploidy, if the chromosome counts are correct.

\* **Utah. Kane Co.** Two specimens at UT are vouchers for populations from which mixed diploid-tetraploid counts were obtained: Kane Co.: "Hundreds of plants growing in Sand Spring stream, [36° 51' N, 112° 46' W], 5100 ft; many very large one (up to 5 ft); cytology indicates mixed diploid-tetraploid population," 23 Jun 1969, *McArthur 25*, culture number "9554 = 7555,"  $n = 14, 28$ . Kane Co.: "Thousands of plants growing in a ditch between lower two lakes at Three Lakes near Kanab. On a previous year I found no plants at this location, 5400 ft; cytology indicates mixed diploid-tetraploid population," 24 Jun 1969, *McArthur 26*, cult. 9555,  $n = 14, 28$ . Both voucher plants have thick-fistulose stems about 8 dm tall. These may represent instances of autotetraploidy. Sand Spring and Three Lakes are within ca. 12 kilometers of each other in Kane County. Moccasin, Arizona, in Mohave County, where diploids and tetraploids also were reported from a single population (see comments above), is near the Utah state line and only about 20 kilometers from these two Utah localities. The occurrence of these three, closely adjacent populations with variation in ploidy seems more than coincidental, or perhaps the phenomenon is more common than reported because of lack of sampling.

\* **British Columbia.** Plants from the Queen Charlotte Islands apparently exist at diploid and tetraploid levels. It has been claimed that the tetraploids are morphologically distinct in having hirtellous, eglandular vestiture but they apparently are not different from some diploids in the Queen Charlotte Islands or from diploids in some other parts of the geographic range of the species. See comments above regarding *E. guttata* subsp. *haidensis*.

\* **Alaska.** Vickery et al. (1968) reported a tetraploid chromosome count for a plant of *Erythranthe guttata* from Admiralty Island (Gambier Bay, sea level to 1000 ft, Aug 1958, *Miller s.n.*, Vickery cult. 6152 (as published) or cult. 6250 (in UT). They observed bivalents frequently "paired in loose quadrivalent associations." Seed-grown plants of this individual produced hybrids in crosses with diploid plants from Contra Costa Co., California, but the F<sub>1</sub>s were sterile. Crosses of the Alaskan tetraploid with what Vickery et al. presumed was autotetraploid *E. guttata* from Arizona (Yavapai Co., *Vickery 2593*, see citation above) would not produce hybrids. Another chromosome count from Alaska has been reported as diploid,  $2n = 28$ : Aleutian Islands, sea cliff on Amchitka Island, *Vickery 11452* (Vickery et al. 1981). Also diploid is "Vicinity of Juneau," *Vickery 5395*, as listed in Vickery (1978). See further comments above under "Morphological variants."



Figure 1. *Erythranthe guttata*. Illustration of *Mimulus langsdorffii* from Botanical Magazine (J. Donn ex Sims, Bot. Mag. 36: plate 1501. 1812). A large-flowered plant from Alaska, perhaps representing a tetraploid individual (see text).

12. **ERYTHRANTHE GRANDIS** (Greene) Nesom, *Phytoneuron* 2012-40: 43. 2012. *Mimulus grandis* (Greene) Heller, *Muhlenbergia* 1: 110. 1904. *Mimulus langsdorffii* var. *grandis* (Greene) Greene, *J. Bot. (Brit. & Foreign)* 33: 7. 1895. *Mimulus guttatus* var. *grandis* Greene, *Man. Bot. San Francisco Bay*, 277. 1894. **LECTOTYPE** (designated here): **USA. California.** [Solano Co.:] Rocky hills 5 mi E from Vallejo, 10 Apr 1874, *E.L. Greene s.n.* (ND-Greene! photo-PH!). No type was cited in 1894 protologue, which noted only "a conspicuous perennial of stream banks and some boggy places among the hills near the Bay."

Another collection of type material at ND-Greene is this: [Alameda Co.:] Berkeley, 20 Aug 1887, *E.L. Greene s.n.*; the label has handwritten "Mimulus grandis Greene." The label for the Solano County collection has "Mimulus luteus grandis" in Greene's handwriting.

- Mimulus procerus* Greene, *Leaf. Bot. Observ. Crit.* 2: 6. 1909. **TYPE: USA. California.** Monterey Co.: Santa Lucia Mountains, Jun 1898, *R.A. Plaskett 156* (holotype: ND-Greene! photo-PH!; isotypes: NY digital image!, US digital image!). Greene noted that the plant is "in every part hirtellous-puberulent."

- Mimulus guttatus* subsp. *litoralis* Pennell, *Proc. Acad. Nat. Sci. Philadelphia* 99: 165. 1947. **TYPE: USA. Oregon.** Lincoln Co.: Sea beach vic. Otter Rock, wet place, bluffs, 19 Jul 1939, *B. Maguire 17304* (holotype: PH!). Pennell noted that this is a "characteristic and magnificent plant that grows in masses along the rocky coast of Oregon and northern California], where it replaces subspecies typicus."

**Perennial**, rhizomatous, sometimes rooting at lower nodes. **Stems, pedicels, calyces, and distal leaves** densely hirsutulous to softly hirtellous-puberulent to pilose-hirsutulous (hairs usually crinkly) and eglandular or with a mixture of hirtellous-puberulent and stipitate-glandular hairs, less commonly sparsely to densely stipitate-glandular or glandular-villous without hirtellous-puberulent vestiture. **Stems** erect, sometimes decumbent at the very base, (25–)50–120(–160) cm, usually fistulose (succulent-thickened and hollow). **Leaves:** basal and lower cauline petiolate, blades ovate to broadly elliptic, 25–60 × 20–40(–60) mm, margins crenulate to dentate, proximally sometimes sublyrate, apex rounded to obtuse, base truncate or truncate-cuneate to subcordate, petioles 10–80 mm, gradually reduced in size distally and becoming subsessile to sessile, bracteate in the inflorescence. **Flowers** 8–26, usually in bracteate racemes. **Fruiting pedicels** 10–35 mm. **Fruiting calyces** 15–22(–25) mm, 10–14 mm wide (pressed), closing, straight or nodding ca. 45°–100°. **Corollas** yellow, red-dotted within, tube-throats (14–)16–24 mm, long-exserted from calyx, limb broadly expanded. **Styles** hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 8–12 mm, stipitate, included.  $2n = 28$ .

**Chromosome vouchers.** **California.** **Monterey Co.:** Pacific Grove, *Vickery 5001*, voucher for  $n = 14$  (UT). **San Mateo Co.:** Pescadero, 30 ft, *Clausen 2083*, voucher for  $n = 14$  (UT).

**Flowering** (Apr–)May–Jul(–Sep). Beaches, dunes, coastal bluffs, wet cliff faces, mud flats and seeps, marshes, drainage ditches, creeks, rarely in coastal sage scrub; 0–200(–800) m. **California,** **Oregon.** Map 10.

The densely puberulent vestiture of pedicels, calyces, and distal stems usually is diagnostic, especially in combination with the extra-sized flowers (corollas and mature calyces) and tall stature. Scattered collections are much shorter than normal but have large corollas and characteristic vestiture (e.g., San Mateo Co., Crystal Springs Lake, Apr 1903, *Elmer 4857* (MO); Santa Clara Co., along Chebaya Road W of Joseph Grant County Park, 6 May 1995, *Doo s.n.* (DAV). *Erythranthe grandis* characteristically occurs in coastal localities but it also is found in inland localities and habitats near the coast but well away from salt spray.

Large-flowered plants in coastal regions of Washington, British Columbia, and Alaska have a different vestiture and the corollas do not reach the size of *Erythranthe grandis* — these plants are an expression of *E. guttatus*, as considered here.

Pennell (1951) placed *Mimulus grandis* in synonymy under typical *M. guttatus*.

13. **ERYTHRANTHE ARENICOLA** (Pennell) Nesom, Phytoneuron 2012-40: 43, 2012. *Mimulus guttatus* subsp. *arenicola* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 166. 1947. **TYPE:** USA. **California.** Monterey Co.: Pacific Grove, sandy clay flat, 0–10 ft, 28 Jun 1940, *F.W. Pennell* 26020 (holotype: PH!; isotypes: CAS digital image!, F digital image!, MICH digital image!, MO!, NY-2 sheets digital images!, UC!, US digital image!). Plants of the type collection are nearly glabrous except for minutely hirtellous calyces.

**Annual**, fibrous-rooted or slender taprooted. **Stems** 3–17 cm, erect, rarely prostrate to prostrate-ascending and rooting at the nodes (*Parish 11528*). **Stems**, leaves, calyces, and pedicels moderately glandular-villous with gland-tipped hairs or mixed hirtellous and stipitate-glandular. **Leaves** basal and cauline, basal short-petiole, cauline sessile, blades suborbicular to broadly ovate or depressed-ovate, 5–17 mm x 6–15 mm, palmately 3–5-nerved. **Flowers** 1–6, at distal nodes. **Fruiting pedicels** 9–17 mm. **Fruiting calyces** ovoid-campanulate, 9–16 mm, closing, nodding. **Corollas** yellow, red-dotted, tube-throats infundibular, 11–20 mm, exerted 4–8 mm beyond the calyx rim, limb expanded 10–18 mm (pressed). **Styles** hirtellous. **Herkogamous**; anther pairs at different levels, stigma above the upper anther pair. **Capsules** ca. 5–12 mm, stipitate, included.

**Flowering** Apr–Aug. Sandy beaches, especially in moist hollows among dunes, sea cliff bases, chaparral near beaches, mudstone outcrops; 0–100 m. **California** (Monterey, San Luis Obispo, Santa Cruz cos.). Map 11.

Pennell (1947, 1951) considered *Erythranthe arenicola* an endemic of Monterey County, but plants from adjacent San Luis Obispo and Santa Cruz counties also belong here. In addition to the Monterey Co. specimen (cited below), Vickery made collections of *E. guttata* and *E. grandis* at essentially the same locality. Most of the localities are at sea side but some are more than a mile inland.

**California.** Monterey Co.: along the coast, Monterey Peninsula, 30 Jul 1929, *Mathias* 743 (MO); Monterey Peninsula, moist seeps in the dunes, Asilomar, Aug 1917, *Parish 11528* (MO); Monterey Peninsula, wet sand among dunes, 29 Aug 1957, *Thorne 18949* (UC); Pacific Grove, seep at high tide mark at the base of cliffs, in a moist pocket of rich soil, ca. 1/2 mi W of Lover's Point, 5 ft elevation, 13 Apr 1956, *Vickery 1*, cult. 5001 (UC, UT). San Luis Obispo Co.: Upper Prefumo Canyon Road, grassy area with scattered patches of chaparral, locally abundant on rock outcrop, flowers yellow with red dots, 29 Apr 1979, *Kell K13058* (TEX). Santa Cruz Co.: Plants of H-H Ranch, ca. 17 mi NW of Santa Cruz, on seasonal waterfall face in S fork of "Gulch #1," in sparse N coastal scrub, slope near vertical, 280 ft, on Santa Cruz mudstone outcrop with small pockets of soil, 800–1000 plants on waterfall face, all plants in population annual, 5 Jun 1983, *Buck 325* (JEPS); between Calif. 1 (Cabrillo Hwy) and Swanton Road, SE of Greyhound Rock and W and NW of old Seaside School (Swanton), no date or collector (JEPS).

*Erythranthe arenicola* is hypothesized here to be a derivative of *E. guttata* or *E. grandis*, retaining the allogamous breeding system of its putative ancestor but becoming reduced in size and duration.

14. **ERYTHRANTHE THERMALIS** (A. Nelson) Nesom, Phytoneuron 2012-40: 44, 2012. *Mimulus thermalis* A. Nelson, Bull. Torrey Bot. Club 27: 269. 1900. **TYPE:** USA. **Wyoming.** [Park Co.:] Upper Geyser Basin, on geyser formations, 3 Aug 1899, *A. Nelson* and *E. Nelson* 6285 (holotype: RM photo-PH!; isotypes: MO!, NY-2 sheets digital images!).

**Annual**, without rhizomes or stolons, very occasionally with a basal, runner-like stem. **Stems** 1.5–10(–15) cm, erect, simple or branched from basal nodes. **Stems, pedicels, and calyces** moderately to densely stipitate-glandular to (less commonly) hirtellous and eglandular. **Leaves** basal and cauline, cauline 2–5 pairs, blades suborbicular to ovate, depressed-ovate, ovate-deltate or reniform, 4–15(–20) mm × 4–20 mm, palmately 3–5-nerved, basal and lower cauline short-petiolate, cauline subsessile to sessile, mostly 5–10 mm, margins evenly crenate-dentate to subentire, apices acute to obtuse or rounded, base cuneate to truncate or subcordate, petioles (basal and lower cauline) 3–20 mm. **Flowers** 1–5(–9), mostly at distal nodes. **Fruiting pedicels** 7–12 mm. **Fruiting calyces** ovate-campanulate 8–11 mm, closing, lobes unequal, deltate-triangular, upper longer than the others, ciliate or glabrous. **Corollas** yellow, red-dotted or apparently sometimes without red markings, tube-throats funnel-form, 8–12 mm, exserted 1–2 mm beyond the calyx margin, strongly bilabiate, expanded 12–15 mm (pressed), throats open, palate villous. **Styles** hirtellous. **Plesiogamous**; anther pairs at about the same level, stigma at the level of the anthers. **Capsules** 5–6 mm, stipitate, included.  $2n = 28$ .

Flowering Mar–Aug. Hot, shallow, quick-drying soils around thermal pools and vents; 2200–2600 m; Wyoming (Park Co.). Not mapped.

Additional collections examined. **Wyoming, Park Co.:** Yellowstone National Park, on the "Formations" and frequent in YNP, 16 Jul 1912, *Churchill 723* (MO-2 sheets, mixed collection of *E. thermalis* and *E. guttata*); Yellowstone National Park, on volcanic soil, Jul 1930, *Demdas s.n.* (DAV); Yellowstone National Park, Firehole Lake (thermal spring), almost in water, 31 May 1958, *Hamlinnechen s.n.*, voucher for  $n = 14$  (UT); Yellowstone Park, Upper Geyser Basin, 24 Jul 1906, *Jepson 2531* (JEPS); Yellowstone Park, Upper Geyser Basin, on formations, 9 Sep 1887, *Kearney s.n.* (ND-Greene); Yellowstone Park, Gibbon Geyser basin, wet banks of hot streams, 10 Jun 1934, *Nelson & Nelson 1073* (MO, UC); Lower Geyser Basin, moist bank, 30 Jul 1951, *Sargent s.n.* (SMU); Firehole River, 3 mi SW of Old Faithful, West Thumb Road, growing next to hot spring, geysersite, 7800 ft, 26 Jun 1960, *Venrick 193* (MO) and *Venrick 194* (MO).

*Erythranthe thermalis* is recognized by its annual duration (without rhizomes), reduced stature and leaf size, and short but broad-limbed corollas with autogamous fertilization. It is endemic to Yellowstone National Park where it grows in hot, shallow, quick-drying soils around thermal pools and vents (not in thermally-influenced waters or creek edges; fide Margaret Kendrick, pers. comm.). Typical *E. guttata* (rhizomatous, allogamous) also grows in the immediately surrounding areas but apparently not in the hot soils.

After I had seen and annotated a number of these plants as *Mimulus thermalis*, the Fishman Lab website (2011) came to my attention — an informal discussion there of these thermal-soil plants appears to provide evidence supporting their treatment at specific rank. In addition to the reduced size, annual duration, and autogamy, adaptive differentiation among Yellowstone plants has produced a difference in phenology that apparently reinforces the autogamy in reducing gene flow. In the interpretation here, autogamy in these plants (as in many other examples in other genera and families) produces effective reproductive isolation, at least in the direction of outcrossing to selfing plants. A fuller assessment will be possible with eventual publication of studies conducted by the Fishman lab.

So interpreted, the Yellowstone situation is the only known example of sympatric speciation in *Erythranthe*. Evolutionary derivation of *E. thermalis* from *E. guttata* seems to be a secure hypothesis, given their morphological similarity and because the latter is the only species of sect. *Simiola* in northwestern Wyoming besides *E. tilingii* and *E. geyeri*, both of which are unlikely progenitors. Among the species of sect. *Simiola* in Wyoming, only *E. geyeri*, *E. guttata*, and *E. tilingii* have been recognized (Nelson & Hartman 1997; Dorn 2001). *Erythranthe thermalis* (as a species of *Mimulus*) has not been included even as a synonym.

A collection of *Erythranthe* aff. *guttata* from a hot springs area in Idaho is rhizomatous but the flowers are very small, outside the range of size for *E. guttata* but still allogamous, and it would be interesting to make further observations of these plants. Corolla tubes ca. 7 mm, styles 9–10 mm, the stigma exerted from the tube and beyond the anthers. **Idaho, Blaine Co.:** Ketchum and Guyer Hot Springs, margins of hot sulphur spring bogs, 5887 ft, 22 Jul 1911, *Nelson and Macbride 1278* (MO, UC).

15. **ERYTHRANTHE LAGUNENSIS** Nesom, sp. nov. TYPE: MEXICO. Baja California Sur. Arroyo San Bernardo ca. 3 km above Boca de la Sierra, near 23° 23', 109° 49', 500 m, in wet sand by stream, 19 Jan 1959, *R.V. Moran 7080* (holotype: SD; isotype: TEX).

Similar to *Erythranthe guttata* in overall habit, inflorescence, and vestiture but different in its annual duration (lacking rhizomes), stems apparently more commonly approaching decumbent, leaves broadly ovate to orbicular-ovate, and calyx lobes with denticulate margins.

**Annual herbs**, fibrous-rooted, without rhizomes but sometimes rooting at proximal nodes. Stems terete, erect to ascending-erect or decumbent-ascending, 12–40 cm. Pedicels, calyces, distal leaves, and distal portions of stems moderately to densely short-villous-glandular with gland-tipped hairs 0.2–1.0 mm, rarely mixed with short, sharp-pointed, eglandular hairs (hirtellous-hirsute). Leaves basal and cauline, basal usually largest, very gradually or very little reduced in size distally until an extended inflorescence, cauline blades mostly broadly ovate to orbicular-ovate, (7–)15–40 mm x (5–)10–35 mm, sessile or basal and proximal with petioles 2–15 mm, usually not punctate (see comments below), palmately (3–)5–7 veined, veins basal to suprabasal, margins shallowly serrate-dentate, 5–10 pairs of teeth per side, sometimes doubly toothed. Flowers 3–15(–26), from mid to distal nodes. **Fruiting pedicels** 7–20(–30) mm, nodding 30°–90°. **Fruiting calyces** 7–14 mm, ovoid, sometimes red-spotted, closing, lobes 5, triangular-acute, upper lobe slightly longer, upper lobe sometimes denticulate with 1–2 pairs of small teeth distally. **Corollas** yellow, red-spotted on palate and base of lower lip, tube-throats funnellform-tubular, 7–12(–14) mm, exerted 4–6(–7) mm beyond calyx margin, limbs bilabiate, 7–10 mm wide (pressed). **Styles** hirtellous with ascending hairs. **Herkogamous**; stamen pairs usually separated but stigma barely above the upper pair, sometimes apparently plesiogamous. **Capsules** 5–7 mm, stipitate, included.

**Flowering** Jan–Apr(–May). Along streams, arroyos, springs, oak and oak-pine woods, riparian woods, dry subtropical deciduous woods, dry washes; (200–)500–2000 m; Mexico (Baja California Sur). Map 12.

**Additional collections examined.** MEXICO. Baja California Sur. From San Jorge to San Francisquito and La Chuparosa, E side of Sierra de la Victoria, Arroyo Santa Rita, 23° 29–31' N, 109° 47–55' W, in granitic sand, with *Populus brandegeei*, *Quercus devia*, *Lysiloma microphylla*, and *Dodonea viscosa*, 840 m, 11 Apr 1955, *Carter & Ferris 3316* (SD); from San Jorge to San Francisquito and La Chuparosa, E side of Sierra de la Victoria, La Chuparosa, open rolling ridge tops with *Pinus edulis*, *Nolina beltingii*, *Quercus devia*, *Arbutus peninsularis*, and *Lepechinia hastata*, 1800 m, at spring, 23° 29–32' N, 109° 47–55' W, 12 Apr 1955, *Carter & Ferris 3353* (SD, TEX); Sierra de la Laguna, Camp. Palo Extranero, 23° 31' N, 109° 56' W, arroyo con agua, bosque de pino y encino, 1850 m, 15 Mar 1987, *Dominguez 440* (SD); Mpio. La Paz, Sierra de la Victoria, Paraje de Cano “El Chalet,” 23° 36' N, 109° 55' W, bosque de encinos, 1670 m, 12 Feb 1997, *Dominguez L. 1758* (SD), *Dominguez L. 1759* (SD); Rancho Santo Domingo (Arroyo), 23.43532° N, 110.02034° W, 497 m, 16 Apr 2008, *Dominguez L. 4027* (SD); Sierra La Laguna, Agua El Salitito, Rancho La Burrera, 23.512268° N, 110.041275° W, selva baja caducifolia, 514 m, 30 May 2008, *Dominguez L. 4096* (SD); Sierra Laguna, La Laguna, granitic gravel of dry wash, oak-pine forest, 6000 ft, 24 Mar 1939, *Gentry 4405a* (ARIZ); Sierra La Laguna, Reserva de la Biosfera, El Salitito de La Burrera, 23.51109° N, 110.04442° W, arroyo, selva baja caducifolia, 535 m, 28 Mar 2008, *Leon de la Luz*

8073 (SD); Cape region, El Chorro, near 23° 26' N, 109° 48' W, near canyon mouth, wet sand by stream, 200 m, 30 Apr 1959, *Moran* 7285 (SD); Cape region, La Laguna, 23° 33' N, 109° 58' W, 1700 m, 27 May 1965, *Sloan s.n.* (SD); Cape region, E slopes of the Sierra de la Victoria, El Reparto, W from Caduño, along stream in moist sand, ca. 2300 ft, 8 May 1959, *Thomas* 7810 (SD); southern outskirts of Miraflores, in wet sand at margin of arroyo, [23° 21' N, 109° 45' W], 8 Jan 1959, *Wiggins* 14735 (ARIZ).

Most of these plants previously have been identified as *Erythranthe guttata* but the annual duration is distinctive and they are far disjunct from the nearest populations of typical *E. guttata* in Baja California (the northern state). The tootching of the calyx margins is seen elsewhere in the genus only in *E. brevinasuta*, suggesting that ancestry of these two endemics of Baja California Sur may be close.

*Gentry* 4403a from La Laguna is distinctive in its low, procumbent habit, hirtellous vestiture, tiny leaves, relatively small calyces and corollas, and punctate leaves, but it is regarded here as a depauperate individual of *Erythranthe lagunensis*. *Sloan s.n.*, also from La Laguna, has an ascending habit with longer stems and larger leaves and corollas, but it has hirtellous vestiture and punctate leaves. *Dominguez* 4027 has minutely hirtellous calyces; *Thomas* 7810 has pedicels mixed hirtellous and villous-glandular; *Moran* 7080 (the type) has calyces mixed hirtellous and villous-glandular. This mirrors the variability in vestiture found in *E. guttata*.

16. **ERYTHRANTHE UNIMACULATA** (Pennell) Nesom, Phytoneuron 2012-40: 44, 2012. *Mimulus unimaculatus* Pennell, Notul. Nat. Acad. Nat. Sci. Philadelphia 43: 5, 1940. **TYPE:** USA. **Arizona.** [Gila Co.:] Sierra Ancha, rim of Pueblo Canyon, 13 May 1931, *G.J. Harrison* 7892 (holotype: PH!; isotype: ARIZ!).

**Annual**, shallowly fibrous-rooted or slender taprooted. **Stems** erect or basally ascending-erect, sometimes rooting at proximal nodes, (2-, 8-)10-30(-50, -100) cm, terete, becoming fistulose in larger plants, stems and pedicels delicately short glandular-villous to stipitate-glandular, often glabrous below the inflorescence. **Leaves** mostly cauline or basal sometimes persistent, proximal short-petiolate, sessile above, connate-perfoliate distally, blades ovate-lanceolate to ovate or broadly ovate-elliptic, midcauline 12-40(-50) x 10-25(-45) mm, proximal sometimes subpinnately nerved, usually with (1-)2 pairs arising from the midvein above the blade base, becoming palmately nerved distally, vestiture a mix of 3 kinds of hairs: sharp-pointed hirtellous, vitreous-flattened, and gland-tipped, margins shallowly dentate-serrate to serrate with 7-12 teeth per side, apex rounded to obtuse, base rounded to truncate or cuneate, petioles 4-10(-15) mm, reduced and bractlike in the inflorescence. **Flowers** (1-)3-14, mostly from midstem and above. **Fruiting pedicels** 10-40 mm, straight. **Fruiting calyces** broadly campanulate, 9-13(-15) mm, closing, nodding 30°-90°, sparsely glandular-villous to stipitate-glandular, lobes triangular-ovate to broadly triangular, upper distinctly longest. **Corollas** pale yellow to nearly white, palate and lower throat densely and dark yellow, drying blue-green, red-spotted, tube-throats funnelliform to subinfundibular, (7-)9-14 mm, exerted 3-4 mm beyond the calyx margin, limbs bilabiate, broadly expanded (8-17 mm pressed), palate densely bearded. **Styles** hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 5-8 mm, stipitate, included.  $2n = 28$ .

Flowering Jan-Jun. Stream and canal sides, pool edges, canyon bottoms, sand, gravel, and mud, tropical deciduous, riparian, and pine-oak forests; 200-2000 m. Arizona (Cochise, Gila, Pima, Santa Cruz cos.), New Mexico (Dona Ana Co.); Mexico (Chihuahua, Sonora). Map 13.

*Erythranthe unimaculata* is recognized by its annual duration (fibrous-rooted, without stolons or rhizomes), delicate-glandular vestiture, mostly sessile to subsessile, often widely spaced leaves,





Figure 2 *Erythranthe unimaculata*, isotype ARIZ

closed fruiting calyces, and relatively large, pale yellow to nearly white corollas with a dark yellow palate that dries blue-green (Fig. 3). The breeding system is allogamous. The plants commonly are single-stemmed but sometimes produce decumbent-ascending stems branching from the very base of the plant, these sometimes rooting at proximal nodes (e.g., *Pringle* 889, *Palmer* 16 and 17, *Ward & Soreng* 82-008; Vickery's greenhouse cultures of *Gentry* 8078 from Chihuahua). Plants of *Blumer* 3433a from the Rincon Mts. are unusually small (1.5-3 cm tall, with 1-2 flowers). Without the basal parts, plants of *E. unimaculata* sometimes may be difficult to distinguish from *E. guttata*.



Figure 3. Flowers of *Erythranthe unimaculata*, from the ARIZ isotype

Additional collections examined. **USA. Arizona. Cochise Co.: Chiricahua Mts.:** S. Fork of Cave Creek Canyon, 5300 ft, 31 Mar 1962, *Barr* 62-185 (ARIZ); *Blumer* 162 (ARIZ); Price Canyon, cold springs, 22 Jul 1907, *Goodding* 2299 (MO); Cave Creek Recreation Park, in running water, 5000 ft, 18-19 Jun 1930, *Goodman & Hitchcock* 1224 (MO); marginal aquatic in Cave Creek, South Fork Road, 0.5 mi from jct of Road 42 and S. Fork Road, 5200 ft, 20 Apr 1989, *Holloway & Cowley* 41 (MO); Cave Creek area, 3500 ft, 1 Apr 1941, *Kimball* s.n. (ARIZ); 1 mi below Rustler Park cattle guard, near water, 7900 ft, 7 Jun 1960, *McCormick* 116 (ARIZ); Cave Creek Canyon, stream bed, 31 May 1929, *Peebles & Loomis* 5860 (ARIZ); Rucker Canyon, along stream near upper road crossing, ca. 6300 ft, 8 Jun 1980, *Toolin* 793 (ARIZ). **Dragoon Mts.:** West Cochise Stronghold, drainage among high boulders, 22 Apr 1962, *Goodding* 60-63 (ARIZ). **Huachuca Mts.:** roadside in Scotia Canyon, wet soil by stream, 5900 ft, 2 Jun 1991, *Bowers* 3503 (ARIZ); Miller Canyon, along old trail in canyon bottom in pine-oak forest, 7300 ft, 30 May 1992, *Fishbein* 372 (ARIZ); along stream, May 1912, *Goodding* 1321 (ARIZ); Ft. Huachuca Military Reservation, head of Garden Canyon, along shallow soil water courses, 13 May 1958, *Goodding* 116-58 (ARIZ); canyon above Sunnyside, near

edge of charco, 13 May 1958, *Goodding 132-58* (ARIZ). **Gila Co.:** Sierra Ancha Wilderness Area, Tonto Natl. Forest: Hunt Spring, at top of Devils' Chasm, off trail 140 ca. 1.5 mi from trailhead, 6500 ft, 13 Jun 1992, *Imdorf 800* (ARIZ); along Trail 139 at Trailside Spring, moist soil, with *Juglans major*, *Vitis arizonica*, *Rhus radicans*, and mixed conifer forest upland, 6800 ft, 22 May 1993, *Imdorf 1243* (ARIZ). **Pima Co.:** Baboquivari Mts.: Brown Canyon, E slope of the Buenos Aires National Wildlife Refuge, *Platanus racemosa*-*Celtis reticulata* riparian forest in canyon bottom in oak woodland-desert grassland transition, ca. 1220 m, common annual in water in streambed, 6 May 1999, *Reina G. 99-101* et al. (UT). **Rincon Mts.:** Manning Camp, springy soils on rocks, 1 Oct 1909, *Blumer 3433a* (UC). **Santa Catalina Mts.:** Upper Sabino Creek, 1 mi W of Summerhorn, ca. 8000 ft, 27 Jun 1960, *Barr 60-70* (ARIZ); Molino Creek, along creek bank in shade, 10 Apr 1985, *Bennett 8744* (ARIZ); ca. 5 mi N of Mt. Lemmon lodge, dirt road above Peppersauce, seeping sandy bank, small spring, 7 Jul 1967, *Crutchfield 3323* (LL); Mt. Lemmon Road, 7000 ft, 6 May 1925, *Nichol s.n.* (ARIZ); Mt. Lemmon, 30 May 1927, *Peebles 4081* (ARIZ); Jun 1907, *Thorner & Lloyd 4334* (ARIZ); Sabino Canyon, 1 Apr 1894, *Toumey 103* (UC); Sabino Canyon, 3 Apr 1894, *Toumey 104* (UC). **Santa Cruz Co.:** Tumacacori Natl. Historic Park/Guevavi Unit, semi-desert grassland, dry benches E off Santa Cruz River, ca. 3400 ft, 20 Mar 2001, *Guertin 142* (ARIZ); Cottonwood Canyon SW of the Santa Rita Mts., moist soil below dam, 16 Mar 1975, *Kaiser 550* (ARIZ); White House Canyon, along streams, 5200 ft, 22 Apr 1917, *Shreve 5176* (ARIZ); Santa Rita Mts., Cave Creek Canyon, streambed, 6200-6800 ft, 3-4 May 1975, *Van Devender s.n.* (ARIZ). **New Mexico. Dona Ana Co.:** W base of Organ Mts., Dripping Springs Canyon, 11 mi E of northern Las Cruces, slow-moving water of a constantly moist, N-facing depression of an unbroken quartz monzonite outcrop, with *Preussia*, *Aquilegia chrysantha*, and mosses, 6000 ft, 25 Apr 1982, *Ward & Soreng 82-008*, voucher for  $2n = 28$  (MO); Organ Mts., 16 Apr 1893, *Wootton s.n.* (MO). **MEXICO. Chihuahua.** Sierra Charuco, Arroyo Hondo, igneous rocky canyon slope in pine-oak forest, riparian, 4500-5500 ft, 16-30 Apr 1948, *Gentry 7993* (ARIZ) and *8078* (ARIZ); Sierra Charuco, *Gentry 8078* [Vickery greenhouse cults. 5322, 5323, 28 Jan 1950] (UT); Ricardo Flores Magón, side of isolated pool in sandy soil, 21 Jun 1964, *Miller M64-9* (UT); 14 mi S of Nueva Casa Grandes, wet sand and gravel by Rio Casas Grandes, 21 Jun 1964, *Miller M64-10* (UT); vicinity of Chihuahua, ca. 1300 m, 8-27 Apr 1908, *Palmer 16* (MO) and *Palmer 17* (MO); river gravel, Chihuahua, 14 Apr 1886, *Pringle 889* (MO); Mpio. Ocampo, Parque Nac. Cascada Basaseachic, in the box canyon at the base of the fall, ca. 1700 m, 26 Apr 1985, *Spellenberg et al. 8021* (NMC); Mpio. Ocampo, Parque Nac. Cascada Basaseachic, in the barranca at the base of the falls, wet clayey soil near base of falls, 1570 m, 25 Apr 1987, *Spellenberg et al. 9054* (NMC); Mpio. Ocampo, Parque Nac. Cascada Basaseachic, moist sandy soil along river between top of falls and campground area, 2000 m, 17 Jun 1993, *Spellenberg et al. 11862* (NMC); Mpio. Ocampo, S-facing igneous cliff with waterfall in pine and oak woods, in most grass on cliff, 2190 m, 17 Jun 1993, *Spellenberg et al. 11905* (NMC); near Colonia Garcia in the Sierra Madres, 7500 ft, 9 Jun 1899, *Townsend & Barber 28* (MO); Mpio. Ocampo, Cascada de Basaseachic, Rio Basaseachic, pine-oak forest, 1800 m, very common herb in water in stream, flrs yellow, 4 Jun 1999, *Van Devender 99-219* et al. (NMC, UT); 2 blocks N of the plaza in old Casas Grandes, 4800 ft, 29 Apr 1976, *Vickery greenhouse cult. 12,181* (UT); willow-shaded stream near Janos, KM 196 on Mexico Rte 2, between Janos and La Ascension, 4250 ft, 29 Apr 1976, *Vickery 2863* (UT); KM 92, Mexico 28 at Fcoíndera bus stop, in drying sandy areas of stream in partial shade, 10 Jun 1976, *Vickery 2917* (UT); Colonia Pacheco, S part of town, "Townsite Pasture," at the Marion Wilson Ranch and adjoining pastures, gravelly, grussy, and sandy soil derived from extrusive igneous rock, creek/S and a river, 2000 m, 1-2 Aug 1972, *Wilson et al. 8579* (ARIZ). **Sonora.** 37 mi NE of Cajeme, on road to Tesopaco, 4 Mar 1933, *Mallery 18* (ARIZ); Mpio. Yecora, Arroyo Los Garambullos, 0.5 km SE of Tonichi, 180 m, uncommon annual in mud at edge of river, flrs white, 30 May 1999, *Reina G. 99-114* et al. (UT); Arroyo El Pilladito, near Tepoca, stream canyon in tropical deciduous forest, 500 m, very common annual in moist soil along canal, "possibly small plants of larger *M. guttatus* types," 2 Apr 2000, *Reina G. 2000-198* et al. [Vickery greenhouse cult. no. 14356] (UT); 13 mi (by road) N of Arizpe, 31 Mar 1959, *Turner 59-51* (ARIZ); Cienega ca. 1 mi E of

Rancho Agua Fria on Rio Saracachi (E of Cucurpe), 9 Apr 1977, *Van Devender s.n.* (ARIZ); upper end of bend in Rio Cuchujaqui at Rancho El Conejo, 12.4 km (by air) S of Alamos, 240 m, uncommon annual under *Taxodium* in moist soil at edge of river, 7 May 1992, *Van Devender 92-581* (ARIZ); below village of Guajaray on Arroyo Guajaray, 6.5 km (by air) NNW of jet with Rio Mayo, tropical deciduous forest in rocky stream canyon, 270 m, scattered in cobbles near arroyo, 18 Mar 1993, *Van Devender 93-450* (ARIZ-2 sheets); Rio Cuchujaqui at El Paso, 150 m, uncommon annual on bank of river, 25 Feb 1995, *Van Devender 95-92* (ARIZ); Arroyo Los Huerigos (tributary of Arroyo San Nicolas) at Mexico 16, 9.3 km E of Tepoca, 3.5 km WNW (by air) of San Nicolas, *Populus brandegei* riparian gallery forest, 650 m, very common annual at edge of stream, 9 Mar 1996, *Van Devender 96-53* (ARIZ); 1.5 km SW of Santa Ana on road to Guadalupe Tayopa, rocky canyon with *Populus brandegei*, tropical deciduous forest on slopes, 775 m, common annual in moist gravel along stream, 21 Feb 1997, *Van Devender 97-210* (TEX); Arroyo Los Huerigos (= A. El Moro, A. San Nicolas), 9.3 km E of Tepoca on Mex 16, 3.5 km (by air) WNW of San Nicolas, *Populus monticola* riparian gallery forest, 650 m, locally common annual in mud at edge of stream, 13 Apr 1999, *Van Devender 99-73* (UT) and *Van Devender 99-78* (UT); Arroyo Tepoca, ca. 1.7 km (by air) NW of Curea, 420 m, locally very common annual in moist soil along stream, 31 May 1999, *Van Devender 99-139* et al. (UT); along Rio Yecora, ca. 1 km (by air) NW of Yecora, 1530 m, solitary herb in moist soil at edge of stream, 2 Jun 1999, *Van Devender 99-186* et al. (UT). Mpio. Onavas, Arroyo de la Uvalamita, Rancho La Mula, 25.5 km SE of Rio Yaqui on Mex. 16, palm-*Bursera* canyon in tropical deciduous forest, 685 m, locally common annual in water at canyon bottom, 1 Apr 2000, *Van Devender 2000-187* et al. (UT); Mpio. de Imuris, 5 km N of Mesa del Romero, 19 km N of Imuris on Mex. 15, Arroyo, Bambuto drainage, cottonwood-willow forest, 980 m, 25 May 2009, *Van Devender 2009-246* (NMC).

17. *ERYTHRANTHE DECORA* (A.L. Grant) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus decorus* (A.L. Grant) Suksdorf, Werdenda 1: 37. 1927. *Mimulus guttatus* var. *decorus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 173. 1924. TYPE: USA. Oregon. [Clackamas Co.] Vicinity of Oregon City, wet meadow, 11 Jun 1905, *M.W. Lyon, Jr. 59* (holotype: MO! digital image! photo-PH!; isotypes: CAS digital image!, NY digital image!, US digital image!).

**Perennial**, rhizomatous (perhaps prolifically so), sometimes producing numerous, long, remotely leafy runners from basal cauline nodes; distal stems, pedicels, calyces, and both leaf surfaces densely and minutely hirtellous (or leaf surfaces sometimes glabrate), pedicel vestiture often slightly deflexed. **Stems** erect, 20–100 cm, simple. **Leaves** cauline, basal mostly absent by flowering, all except distalmost petiole, blades broadly ovate-triangular to ovate-lanceolate, 20–50(–60) × 10–30(–40) mm, palmately (3–)5–7-veined, apices acute, bases rounded to truncate to shallowly cuneate, petioles 8–25 mm (proximal) to 3–5 mm (distal). **Flowers** (1–)2–7(–14), from distal nodes. **Fruiting pedicels** 18–35(–40) mm. **Fruiting calyces** ovoid, 15–19 mm, green or sometimes red-spotted, closing, lobes deltate to shallowly ovate, apiculate, 1–3 mm, sinuses villous. **Corollas** yellow to chrome yellow, usually red-spotted on floor of throat and tube, tube-throats broadly funnelliform-infundibular, 18–26 mm, exerted (8–)10–15 mm beyond calyx margin, limb bilabiate, expanded 22–30 mm (pressed). **Styles** minutely and prominently hirsutulous to villousulous with ascending to spreading hairs. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 8–10 mm, stipitate, included.

Flowering May–Aug. River banks, stream sides, dripping banks, moist meadows; 1000–1600 m. Idaho, Oregon, Washington. Map 14.

*Erythranthe decora* is distinct in its uniformly ovate to ovate-lanceolate leaf blades with truncate bases and regularly toothed margins, relatively long internodes, rhizomatous habit, mostly unbranched stems, often with leafy runners from basal nodes, large corollas, hairy styles, and

minutely hirtellous stems, pedicels, calyces, and leaf surfaces. The thin, densely produced rhizomes suggest a relationship with the *E. tilmgii* group.

Plants of a collection from Idaho appear to be widely disjunct but they are a good match for those of *Erythranthe decora* in Washington. **Idaho.** Clearwater Co.: Morris Creek drainage, near headwaters of Morris Creek and Old Growth Cedar Grove, along FR 1969d, 0.5 mi from jct of FR 1969, ca. 1.3 air mi N of Shattuck Butte, 12.2 mi NNE of Elk River by road, riparian area along Morris Creek dominated by *Carex* sp., *Phalaris arundinacea*, and *Alnus* sp., 4300 ft, plants occasional along wet stream banks, 21 Jul 1996, Richardson 478 (UC).

Two collections are mapped (Map 14) from citations by Grant (1924): **Oregon.** Multnomah Co.: Portland, along a mountain stream, 3 Jul 1903, Lunnell s.n. (RM); [Linn Co.:] Calapooya Valley, swampy ground, 3500 ft, 17 Jul 1899, Barber s.n. (RM).

**18. ERYTHRANTHE SCOUERI** (W.J. Hooker) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus scouleri* W.J. Hooker, Fl. Bor.-Amer. 2: 100. 1838. *Mimulus guttatus* subsp. *scouleri* (W.J. Hooker) Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 166. 1947. TYPE: USA. **Oregon.** Columbia River, no date, Dr. Scouler s.n. (holotype: K, apparently seen by Pennell, photo-PH!). The photo at PH is of a plant collected by Douglas in 1825. The protologue noted that "There are no flowers to these specimens ..." and provided only a brief description: "glaberrimus, caule erecto basi ramoso, foliis petiolatis lanceolatis dentatis 5-nerviis floralibus brevioribus subovatis, pedunculis folio brevioribus, calycibus demum inflatis."

**Perennial** (presumably rhizomatous, full base not seen), completely glabrous throughout. Stems erect, 15–80 cm, simple, producing long, sparsely leafy runners from basal nodes. Leaves cauline, basal mostly absent at flowering, blades (basal to medial) oblong-elliptic to oblong-lanceolate, 25–60 mm x 8–18 mm, palmately (3–)5–7 veined to subpinnate, margins evenly and very shallowly dentate or crenate to mucronate or mucronulate with 10–20 teeth per side, sometimes more deeply toothed at the very base, proximal and medial petiolate with bases attenuate to a petiolar region 10–25 mm, distal sessile. **Fruiting pedicels** 20–25 mm. **Fruiting calyces** 13–14 mm, closing, lobes deltate-acuminate, subequal. **Corollas** yellow, apparently without red markings, tube-throats infundibular, 20–24 mm, exserted ca. 10–15 mm beyond calyx margin, limb bilabiate, expanded 22–30 mm (pressed). **Styles** minutely and prominently hirsutulous to villousulous with ascending to spreading hairs. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** not seen.

**Flowering** May–Aug. **Seeps**, river and creek banks; ca. 1000 m. **Oregon.** (John Day River, a tributary of the Columbia River, in Clatsop, Grant, Wheeler, Sherman, and Gilliam cos.). Map 14.

**Additional collections examined.** **Oregon.** [Clatsop Co.:] S shore of Columbia River, above Astoria, 1883, Meehan 15739 (MO); John Day, 20 Aug 1902, Sheldon 10181 (UC); John Day, near Tongue Point, 20 Aug 1902, Sheldon 11136 (MO).

*Erythranthe scouleri* is distinctive in its oblong-elliptic leaves with long-tapering bases and closely toothed margins, completely glabrous vestiture, long, leafy runners from basal cauline nodes, large corollas with broad limbs, and prominently hairy styles. Several features of the species are interpreted here as suggestive of a close relationship to *E. decora*, particularly its very large corollas, hairy styles, closely toothed leaf margins, tall, simple, and erect stems, numerous runners, and its geographic range.

*Erythranthe scouleri* was treated as a distinct species by Howell, (Fl. N.W. Amer. 5: 520. 1901) and by Pennell (1951), but it was subsequently recognized as a synonym or infraspecific entity

within *Mimulus guttatus* — or sometimes not recognized even as a synonym. Pennell (1947, p. 166) noted this: "We need to know whether the narrow-leaved *Mimulus scouleri* Hook., from along the Columbia River, be actually a local subspecies of *M. guttatus*, or if it pertain to abnormally narrow-leaved individual plants. The Academy's herbarium shows specimens resembling Scouler's type from near Astoria in Clatsop County, Oregon, where they were gathered by Thomas Meehan in 1883, not far from Scouler's locality of a half century earlier; and from the John Day valley farther east in Oregon, gathered by E.P. Sheldon in 1902 (his number 10181)."

*Erythranthe scouleri* is not represented among Oregon's formally listed RTE species (Oregon Biodiversity Information Center 2010), but perhaps this is at least in part because of the current encompassing concept of *E. guttata*.

19. **ERYTHRANTHE MICROPHYLLA** (Benth.) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus microphyllus* Benth., Prodr. (DC.) 10: 371. 1846. *Mimulus langsdorffii* var. *microphyllus* (Benth.) A. Nels. & Macbride, Bot. Gaz. 61: 44. 1916. *Mimulus guttatus* var. *microphyllus* (Benth.) Pennell ex Peck, Man. Pl. Oregon, 654. 1941. TYPE: USA. Washington. [Wahkiakum Co.:] "In rupibus ad flum. Oregon, (Douglas!)" (holotype: K). Pennell (1951, p. 710) noted that the locality visited by Douglas is "Tongue Point, in the present Wahkiakum County, Washington." Treated as a distinct species by Pennell (1951), who noted that its range is "Cascade Mountains and coastal forests from northern Washington to northern California, east to central Idaho."

*Mimulus luteus* var. *depauperatus* A. Gray, Geol. Surv. Calif., Botany 1: 567. 1876. *Mimulus guttatus* var. *depauperatus* (A. Gray) A.L. Grant, Ann. Missouri Bot. Gard. 11: 170. 1924. TYPE: USA. California. [Mendocino Co.:] banks of Navarro River, under moist rocks, [Apr] 1865, H.N. Bolander 4516 (GH photo-PH!). In the protologue synonymy Gray cited *M. microphyllus* and "*M. tenellus*, Nutt. herb., not of Bunge" and some have interpreted *M. microphyllus* and var. *depauperatus* as homotypic (e.g., Holmgren 1984). In the Synoptical Flora, Gray noted (p. 448) that this is "an extreme depauperate form, either seedling or showing the creeping stolons; ... Grows with the larger forms on Columbia River; specimens exactly like those of Douglas from the same district (except that some show the stoloniferous base) were received from Mrs. Barrett." Gray may have included *M. longulus*, with extremely reduced corollas, in his concept of var. *depauperatus*, but the GH type appears to show the larger corollas of *M. microphyllus*.

*Mimulus tenellus* Nutt. ex A. Gray [in synonymy under *M. luteus* var. *depauperatus*], Geol. Surv. Calif., Botany 1: 567. 1876; Proc. Amer. Acad. Arts 11: 98. 1876 [not *M. tenellus* Bunge, Enum. Pl. Chin. Bor. 49. 1833].

*Mimulus luteus* Pennell ex Peck, Man. Pl. Oregon, 655. 1941. TYPE: USA. Oregon. Deschutes Co.: Elk Lake, gravelly shore, 27 Jul 1931, F.W. Pennell 15547 (holotype: PH!; isotypes: CAS digital image!, F digital image!, MO!, NY digital image!, UC!, US digital image!).

*Mimulus glareosus* Greene, Pittonia 1: 282. 1889. TYPE: USA. California. Lake Co.: Gravelly margins of mountain streams, 30 Aug 1888, E.L. Greene s.n. (holotype: ND-Greene! photo-PH!; isotype: UC). The protologue noted "Most related to *M. laciniatus* of the Sierra Nevada; the calyx like that of *M. nasutus*."

*Mimulus guttatus* var. *insignis* Greene, Man. Bot. San Francisco Bay, 277. 1894. *Mimulus langsdorffii* var. *insignis* (Greene) Greene, J. Bot. (Brit. & Foreign) 33: 7. 1895. *Mimulus nasutus* var. *insignis* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 181. 1924. LECTOTYPE (designated here): USA. California. [Napa Co.:] Napa River Basin, low meadows near La Lomita, 26 Apr 1893, W.L. Jepson s.n. (ND-Greene 46297!; islectotype: ND-Greene!; probable islectotypes: JEPS, UC-3 sheets). The ND-Greene label has handwritten by Greene "*Mimulus guttatus* D.C. var. *insignis* Greene."

The protologue noted only "of Napa and Sonoma counties, and the most beautiful *Mimulus* in our flora." Besides the collection designated here as lectotype, other collections from Sonoma County are at ND-Greene and identified as var. *insignis*. The JEPS collection has been referred to as the holotype, as the label (apparently written by Jepson) notes that it is "The very type": La Lomita, near Yountville, 26 Apr 1893, *W.L. Jepson 8m* (JEPS!; duplicates: UC-3 sheets!).

*Mimulus nasutus* var. *insignis* was inadvertently and incorrectly referred to as "var. *eximius* (Greene) Grant" by J.T. Howell (Marin Fl., 242, 1949).

*Mimulus langsdorffii* var. *californicus* Jepson, Fl. W. Mid. Calif., 407, 1901. TYPE: USA. California. [Solano Co.]: Vacaville, 20 Mar 1901, *W.L. Jepson 1198a* (holotype: JEPS digital image! photo-PH!). An annotation by Thomas Robbins in 1953 notes this: "The original description states only that this variety is 'Common in the Sacramento and Coast Range Valleys. Apr-May.' This collection is cited as the type ... by Jepson in Fl. Calif. ined. ms." As described by Pennell (1951): "[blade base] rounded or cordate to petiole (often obscured by extra lobules on petiole)."

*Mimulus platycalyx* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 167, 1947. TYPE: USA. California. Mariposa Co.: Yosemite National Park, 1 mi. S of Wawona, mossy soil over granitic rock, 4500 ft, 28 May 1940, *F.W. Pennell 25580* (holotype: PH!; isotypes: CAS digital image!, NY digital image!, UC, US digital image!). On the holotype, some plants have a hirtellous vestiture of stiff, sharp-pointed hairs mixed with a few gland-tipped hairs; others have calyces and pedicels moderately villous with loose, gland-tipped hairs. Otherwise, they are similar in morphology and all would appear to be from the same population.

**Annual**, fibrous-rooted. **Distal stems and pedicels** hirtellous (hairs commonly deflexed) or mixed hirtellous and stipitate-glandular, sometimes only short villous-glandular with gland-tipped hairs, stems commonly completely glabrous below the inflorescence. **Stems** erect, (3–)5–30(–45) cm, usually simple, sometimes with numerous branches from basal cauline nodes, sometimes distinctly 4-angled. **Leaves** usually basal and cauline or basal sometimes absent at flowering, basal or proximal to medial petiolate, becoming sessile distally, blades ovate or ovate-lanceolate to elliptic-ovate, suborbicular, or depressed-ovate, (3–)10–35 mm x 3–25 mm, palmately 3–5-veined, often purplish, glabrous to sparsely or moderately hirtellous, eglandular, margins shallowly crenate to sharply crenate-serrate, with 5–10 teeth per side, basal and proximal often irregularly incised near the petiole and sublyrate, apices acute to obtuse-rounded, bases rounded to truncate or subcordate, petioles 3–25(–35) mm. **Flowers** 1–8(–14), mostly from distal nodes. **Fruiting pedicels** 8–30(–50) mm. **Fruiting calyces** ovoid-campanulate to broadly cylindric-campanulate, (7–)9–16(–20) mm, strongly to weakly closing, nodding 30°–90°, sometimes red-tinged or red-dotted, minutely hirtellous, hairs sometimes reduced to the basal cells or altogether absent and the calyx glabrous. **Corollas** yellow to golden-yellow or orangish-yellow, commonly red-spotted, sometimes with a large red blotch on the lower lip (Napa and Sonoma counties), tube-throats broadly funnelform to infundibular, (6–)8–16(–20) mm, exerted (1–)2–6(–8) mm beyond the calyx margin, limb bilabiate, expanded 8–25 mm (pressed), palate villous. **Styles** sparsely hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 6–9(–11) mm, stipitate, included.  $2n = 28, 56$ .

Flowering Mar–Jul. Rock depressions, rocky ridges, cliff faces, road cuts, wet meadows, seeps, stream banks, drying ponds and ephemeral stream channels, vernal springs over serpentine, roadsides and roadside ditches, dry banks, lava soil, loam, clay, gravel, yellow pine, oak-pine, mixed oak, oak-chaparral; 20–1700(–2200, –2600) m; California, Idaho, Nevada, Oregon, Washington; British Columbia. Map 17.

A tetraploid population identified as *Erythranthe microphylla* was discovered in San Luis Obispo Co., California (Lowry et al. 2008). Upon finding that plants of the SLO population

(identified in the study as the "inland annual race of *Mimulus guttatus*") had more than two alleles at multiple loci, an analysis with flow cytometry revealed the tetraploidy.

A report of  $2n = 15$  for this species (Vickery et al. 1968, as *Mimulus platycalyx*, from San Mateo Co., California) is regarded here as  $2n = 14$ , as the authors originally surmised might be the case. Vickery (1974, p. 69) noted that "the 15th pair of chromosomes [may be] B chromosomes. Actually the present crossing results strengthen that hypothesis considerably" and in that publication (p. 43), he reported the number as " $n = 14 + 1 B$  chromosome."

*Erythranthe microphylla* is characterized by its annual duration (fibrous-rooted), usually simple stems, relatively widely spaced leaves, glabrous to hirtellous vestiture, open corollas, and calyces closing at the throat. Even in the smallest corollas, the stigma is positioned above the upper anther pair, indicating that all are primarily allogamous. Some plants have basal and lower cauline leaves with exaggeratedly and irregularly toothed-incised margins, especially in Lake and Napa counties (whence the types of *Mimulus glareosus* and *M. guttatus* var. *insignis*, respectively), but a similar tendency can be seen over most of the geographic range.

Plants of *Erythranthe microphylla* vary greatly in height, leaf size, and flower size (the larger flowers approaching the size of those in *E. grandis* and *E. decora*) yet all seem to be within the expression of a single species. Some collections have been made to show this striking range of size within a population, multiple collections from a single county or general locality show the wide variability, and an observant collector made this label observation "Flowers varying in size and number with the vigor of the plant" (Coos Co., Oregon, Cronquist 6853, MO). Plants of the Sierra Nevada, mostly south of El Dorado County, commonly are in the smaller size range and are those identified by Pennell as *Mimulus platycalyx*. The type of *Mimulus microphyllus* also was described from smaller plants.

Problems in identification can be encountered when small plants of *Erythranthe microphylla* and *E. guttata* are collected without the base. Without a clear indication that rhizomes are part of the plant, small individuals of *E. guttata* can be very similar to *E. microphylla* but the latter contrasts in its 4-angled stems, different branching pattern (see Baker and Diggle 2011, who studied *E. microphylla* and *E. grandis*), pedicels glabrous or sometimes sparsely glandular, never hirtellous, and corollas often more golden yellow (with slightly added orange).

**20. ERYTHRANTHE MARMORATA** (Greene) Nesom, *Phytoneuron* 2012-40: 44. 2012. *Mimulus marmoratus* Greene, *Erythraea* 3: 73. 1895. **LECTOTYPE** (designated here): **USA, California.** Stanislaus Co.: Knight's Ferry, [moist rocks,] 9 Apr 1895, *F.W. Bancroft s.n.* (ND-Greene 046328!; photo-PH!; photo UT!; isoelectotype: ND-Greene 046329!). Fig. 4 (lectotype).

*Mimulus whipplei* A.L. Grant, *Ann. Missouri Bot. Gard.* 11: 184. 1924. **TYPE: USA, California.** [Calaveras Co.:] Hillsides and rocky places, Murphy's, 14 May 1854, *J.M. Bigelow s.n.* (holotype: GH digital image!; photo-PH!; isotype: US digital image!). Fig. 3 (holotype and isotype).

**Annual**, taprooted; stems, pedicels, leaves, and calyces commonly densely villous-glandular, sometimes less densely so. **Stems** erect, 7–28 cm, unbranched or branched from the base. **Leaves** mostly cauline or the basal persistent, blades ovate or broadly ovate to elliptic-ovate or depressed-ovate, (10–)15–30 mm x 6–15 mm, palmately (3–)5-veined, margins shallowly to coarsely dentate, apices acute, bases truncate to shallowly cuneate, proximal to medial petiolate, petioles 7–15 mm. **Flowers** axillary from middle to distal nodes. **Fruiting pedicels** 15–45 mm. **Fruiting calyces** broadly campanulate, 9–12 mm, sharply nodding, often densely purple-spotted, densely hirtellous or less commonly to sparsely stipitate-glandular, densely villous at the sinuses, closed, teeth broadly triangular-acute, unequal, the upper scarcely twice the length of the others. **Corollas** yellow, red-



spotted in throat with a large red blotch at base of lower lip, tube-throats narrowly cylindric-funnelform, 10–12 mm, exserted 4–5 mm beyond calyx margin, limbs bilabiate, abruptly expanded 14–20 mm. Styles glabrous to sparsely hirtellous. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** 6–9 mm, stipitate, included.

Flowering Mar–May. Not known but apparently not over serpentine; ca. 100–900 m. California, Stanislaus and Calaveras cos. (Stanislaus River drainage) and Amador Co. (Mokelumne River drainage). Map 20. Figs. 3, 4, 5, and 6.

Additional collections examined. **California.** Amador Co.: Mokelumne River, 1892, *Hansen s.n.* (ND-Greene); Mokelumne River, 1892, *Hansen s.n.* (ND-Greene); Mokelumne River and immediate tributaries, Fischer's Cabin, 1200 ft, 13 May 1896, *Hansen 473* (ND-Greene).

The label for *Hansen 473* specifies "Amador and Calaveras Counties," but Hansen's 1892 and 1893 collections give only "Mokelumne River" as the locality. The Mokelumne River crosses or forms the border of five California counties: Alpine, Amador, Calaveras, San Joaquin, and Sacramento, and placement of the Amador County symbol on Map 20 assumes that all three Hansen collections were made at or near the same place.

*Erythranthe marmorata* is recognized by its erect, taprooted habit and annual duration, villous-glandular vestiture, ovate-petiolate leaves; flowers from middle to distal nodes, long, narrow corolla tubes abruptly flaring into a broad limb, lower middle corolla lobe with a large red blotch, and fruiting calyces dark-spotted and sharply nodding. On two of the five plants of the lectotype sheet, the lower nodes have produced adventitious roots, but this perhaps was in response to partial burial of the stem, because the other three plants, as well as the two on the isoelectotype and those of the other collections (Figs. 5 and 6), have slender taproots.

The species most similar to *Erythranthe marmorata* are *E. microphylla*, *E. pardalis*, and *E. nasuta* — all three are annuals and placed here in the *E. microphylla* group (subgroups A and B). *Erythranthe pardalis* is partially sympatric with *E. marmorata* in Calaveras and Amador counties and the range of *E. marmorata* is completely within the ranges of both *E. microphylla* and *E. nasuta*. Contrasting features of *E. marmorata* with these three species are given here.

*Erythranthe microphylla* roots consistently fibrous, cauline vestiture usually glabrous below the inflorescence, leaves glabrous to sparsely or moderately hirtellous, eglandular, flowers commonly produced mostly from distal nodes; corolla tubes usually broadly funnelform to infundibular, lower corolla lobe without a prominent red blotch.

*Erythranthe pardalis*: cauline vestiture sparsely and more delicately glandular, flowers usually produced at all nodes, including the basal, corolla tubes shorter and the flowers autogamous, lower corolla lobe without a prominent red blotch.

*Erythranthe nasuta* cauline vestiture usually glabrous except at the nodes, leaves characteristically hirtellous on one or both surfaces, flowers often chasmogamous and cleistogamous on a single plant, corollas short-tubed, barely chasmogamous to cleistogamous and the flowers autogamous, calyces with a longish, protruding upper lobe.

In the present study, a realistic concept of *Erythranthe marmorata* was not formed until after study of the type material at ND-Greene in January 2012. It seems likely that collections of *E. marmorata* may be present among the large number of specimens examined earlier at UC-JEPS, where they presumably would have been identified as *E. microphylla*. The likelihood that I identified them as either *E. nasuta* or *E. pardalis* is small.

Grant (1924) treated *Mimulus marmoratus* as a synonym of *M. guttatus* var. *arvensis*. Pennell (1951) treated it as a synonym of *M. nasutus*, apparently basing his assessment on examination of a photo at PI of the ND-Greene type. Beyond that, *M. marmoratus* has been treated variously in synonymy except, apparently, in two places.

\* The Mcnair website (The *Mimulus* Page 1996), notes that *Mimulus marmoratus* "appears to be restricted to a small area of Calaveras County, California. It is obligately annual and appears to be self-fertilising. We found it growing on the basalt and conglomerate at the top of Table Mountain, Calaveras Co, in a situation *M. guttatus* would be unable to grow." An accompanying photo shows a plant identified as *M. marmoratus* from Knight's Ferry (near Table Mountain) — an unequivocal identification is not possible from the photo but the seemingly procumbent habit, subpinnately multi-veined leaves, and the very small (see lens cap for comparative size) and relatively small-limbed corollas without prominent red markings on the lobes strongly suggest that it is *Erythranthe floribunda* (Douglas ex. Lindl.) Nesom of sect. *Mimulosma* (Nesom 2012a). This also would be consistent with Mcnair's description of the species as "self-fertilizing," which *E. marmorata* certainly is not.

\* The CalPhotos website (2010) provides photos by Dean Wm. Taylor of plants identified as *Mimulus marmoratus* from Mariposa County. The ovate-lanceolate, subpinnately multi-veined leaf blades and the relatively large and relatively broad-limbed corollas with prominently massed red dots at the base of the lower three lobes indicate that these plants are *Erythranthe geniculata* (Greene) Nesom of sect. *Mimulosma*.

The identity of *Mimulus whipplei* has long been problematic. According to CNPS (2011), "many recent searches have not rediscovered this plant" and it has remained known only from the type collection. Within *Erythranthe*, the lack of mature calyces on the type has prevented an unequivocal decision even regarding its position in the genus. Grant (1924) placed it among the species of *Mimulus* sect. *Simiolus*, while Pennell (1951) placed it in sect. *Paradanthus*, keying it among the smaller set of species now regarded as *Erythranthe* sect. *Mimulosma* (Nesom 2012a). Grant's protologue did not compare *M. whipplei* with any other species nor did she provide any comments in distinction — her key to species seemingly identifies it as closer to South American species than to those of sect. *Simiola* in the western USA, emphasizing the glandular-villous stems and open corolla throats of *M. whipplei*. Nor did Pennell comment on his placement of the species.

Remarkably, the type of *Mimulus whipplei* was collected from a locality only about 15 miles northeast of the type locality of *M. marmoratus*, and the two taxa are similar in general aspect and especially in their long-tubed corollas with broadly flaring limbs. Examination of the type of *M. marmoratus* in the Greene herbarium confirmed that both taxa are villous-glandular, taprooted annuals. Argue (1980, p. 83) noted that an examination of the pollen of *M. whipplei* "should quickly resolve the disagreement over its proper placement" since species of sect. *Simiolus* have irregularly synaperturate (usually  $\pm$  spiraperturate) pollen, a type unique within all of *Mimulus* sensu lato. In sum, it is clear that the names *M. marmoratus* and *M. whipplei* apply to the same species.



Figure 4. *Mimulus whipplei*, holotype (GH) and isotype (US)



Figure 5. Lectotype (ND-Greene) of *Mimulus marmoratus*.

Figure 6. *Erythranthe marmorata* from Calaveras Co., California (see comments in text).



21. **ERYTHRANTHE GLAUDESCENS** (Greene) Nesom, *Phytoncuron* 2012-40: 43. 2012. *Mimulus glaucescens* Greene, Bull. Calif. Acad. Sci. 1: 113. 1885. *Mimulus guttatus* var. *glaucescens* (Greene) Jepson, Man. Fl. Pl. Calif., 928. 1925. **TYPE:** USA. California. Butte Co.: 1883, Mrs. R.M. Austin s.n. (holotype: ND-Greene! photo-PH!, photo-UT!; isotype: CAS digital image!).

Annual, slender taprooted or fibrous-rooted, mostly glabrous and more or less conspicuously glaucous. **Stems** erect, (5-)30–60(–80) cm, simple or branched, terete, occasionally quadrangular above, rarely with runners from basal nodes. **Leaves** basal and cauline, proximal ovate to ovate-elliptic or orbicular-ovate, sometimes subcordate, 10–50 mm, palmately 3–5-veined, margins denticulate to dentate or coarsely and irregularly toothed, occasionally lobed at the base, petioles slender, as long as or much longer than the blade, sometimes pubescent or villous, distal leaves few, sessile, orbicular, 5–45 mm wide, connate-perfoliate below the inflorescence and disc-like, margins nearly entire or with small scattered teeth. **Flowers** 1–16, commonly from distal nodes, sometimes from nearly all. **Fruiting pedicels** 10–50 mm. **Fruiting calyces** broadly campanulate, 7–16 mm long, closing, lobes short, broadly triangular, blunt to acute, the upper slightly longer. **Corollas** yellow, lower lip densely dark yellow, others much lighter, red-dotted on floor of throat and tube, sometimes with a median blotch, tube-throats 12–23 mm, exerted 4–8 mm beyond the calyx margin, bilabiate, limb expanded 14–36 mm (pressed). **Styles** minutely hirtellous-puberulent. **Herkogamous**; anther pairs at different levels, stigma above upper anther pair. **Capsules** ca. 5–11 mm, stipitate, included.  $2n = 28$ .

Flowering Mar–May(–Jun). Seepage areas, wet rocks, moist cliffs, pool edges, gravelly stream banks, serpentine outcrops, roadsides and roadcuts, low pastures, riparian woodland, blue oak woodland, chaparral, grassland; 80–900(–1100) m; California (Butte and Tehama cos.). Map 18.

The basal leaves of *Erythranthe glaucescens* are very similar to those of *E. microphylla* — often nearly round in outline, with irregularly toothed margins, and often pulplish. Corollas of *E. glaucescens* are widely variable in size, also similar to the situation in *E. microphylla*.

The McNair website (Macnair 1996) makes this observation regarding *Erythranthe glaucescens*: "Pennell [1951] suggests that it is annual, but it behaves as a perennial in the glasshouse, unlike the obligate annual segregants of *M. guttatus*." In the present study, all collections seen of *E. glaucescens* except two (both from a single locality) have been fibrous-rooted or slenderly taprooted and clearly annual. Plants from one locality produced filiform, small-leaved runners from basal cauline nodes: California. Butte Co.: Canon of Big Chico Creek, 26 Mar 1914, Heller s.n. (MO) and 2 Jul 1914, Heller s.n. (MO). McNair did not say what observations led him to interpret the duration of *E. glaucescens* as perennial.

22. **ERYTHRANTHE NUDATA** (Curran ex Greene) Nesom, *Phytoncuron* 2012-40: 44. 2012. *Mimulus nudatus* Curran ex Greene, Bull. Calif. Acad. Sci. 1: 114. 1885. **TYPE:** USA. California. Lake Co.: Kelsey Mountain, Jun 1894, Mrs. Curran s.n. (CAS?; not located at ND-Greene).

**Annuals**, glabrous or stems, leaves, and pedicels minutely stipitate-glandular with hairs 0.05–0.1 mm, at least just above the nodes. **Stems** erect or ascending, (5-)9–30 cm, terete, simple or branched from basal nodes, branches mostly reddish-purple. **Leaves** scattered, proximal blades lanceolate or oblong-lanceolate to ovate, distal narrower, narrowly spatulate to oblanceolate, 5–15(–30) mm × 1–5 mm, margins denticulate to proximally dentate-lobed, bases attenuate, long-petioled (petioles mostly 5–30 mm), the upper sessile and mostly linear, not perfoliate. **Flowers** 1–8, often in proximal or medial to distal axils. **Fruiting pedicels** 10–35 mm, erect in flower, spreading to divaricate or rarely recurved in fruit. **Fruiting calyces** ovate-campanulate, 6–13 mm, closing, lobes nearly equal, obtuse to acute, lower upcurved over the lateral ones and nearly closing the orifice.

Corollas yellow, red-spotted on floor of the throat and tube, tube-throats cylindric-funnelform, 8–12 mm, exerted 2–4 mm beyond calyx margin, bilabiate, limb expanded 8–12 mm (pressed). Styles glabrous. Herkogamous; anther pairs at different levels, stigma above upper anther pair. Capsules 6–7 mm, stipitate, included.

Flowering Apr–Jun. Open gravelly seeps on serpentine outcrops, serpentine crevices, springs, stream sides, gravelly creek beds, roadside drainages and swales; 250–700 m; California (Colusa, Glenn, Lake, Mendocino, Napa, and Sonoma cos.). Map 18.

*Erythranthe mudata* is distinct in its annual duration, few, inconspicuous, and narrow leaves, long and spreading-divaricate pedicels, and large corollas. The plants apparently are true to serpentine substrate. A presumption that *E. guttata* is its "progenitor" (Gardner & Macnair 2000) is without documentation or any other kind of justification.

23. **ERYTHRANTHE NASUTA** (Greene) Nesom, *Phytoneuron* 2012-40: 44. 2012. *Mimulus nasutus* Greene, *Bull. Calif. Acad. Sci.* 1: 112. 1885. *Mimulus langsdorffii* var. *nasutus* (Greene) Jepson, *Fl. W. Calif.*, 407. 1901. *Mimulus guttatus* var. *nasutus* (Greene) Jepson, *Man. Fl. Pl. Calif.*, 928. 1925. **LECTOTYPE** (Grant 1924, p. 179): USA. California. Sonoma Co.: Knights Valley, Apr 1877, *H.T. Edwards s.n.* (GH; islectotype: NY digital image!). The lectotype selection was made from collections noted in the protologue: "Our earliest specimens were collected in 1877, in Sonoma County, Cal. at Knight's Valley and Skaggs' Springs, by Mr. Henry Edwards. Mrs. R.M. Austin sent it from Butte County in 1883; while Mrs. Curran obtained fine specimens last year in localities as far apart as Lake and Kern counties." No specimen matching any of these possible collections was located at ND-Greene.

Greene (1885) made these observations about the new species: "Its calyx is more uniformly spotted than in the true *M. guttatus*, from which it is most obviously distinct by its quadrangular winged stem, its inflorescence, racemose almost from the very base, and its small corolla, but especially by the peculiar calyx, the upper tooth of which not only almost equals the tube in length but is rendered singularly conspicuous by the enfolding about it, of the lower ones; which latter thus disappear entirely from the profile, if we may so speak, thus suggesting the specific name." Latin, *nasutus*, large-nosed.

*Mimulus luteus* var. *gracilis* A. Gray ex Torrey, *Rep. U.S. Mex. Bound.*, *Botany* 2(1): 115. 1859. *Mimulus guttatus* var. *gracilis* (A. Gray ex Torrey) G.R. Campbell, *Aliso* 2: 328. 1950. **LECTOTYPE** (Campbell 1950, p. 336): USA. California. Napa Co.: on rocks, Mar 1852, *G. Thurber 498* (GH, photo! in Campbell 1950). Protologue: "Copper Mines, New Mexico, and near Cruces; Bigelow. Gila valley; Schott. Napa county, California; Thurber. San Luis Obispo; Parry."

*Mimulus subreniformis* Greene, *Erythra* 3: 67. 1895. **LECTOTYPE** (designated here): USA. California. Shasta Co.: Burney Falls, 30 May 1894, *M.S. Baker* and *F. Nutting s.n.* (ND-Greene 46422! photo-PH!, photo-UT!; islectotypes: ND-Greene!, UC!).

*Mimulus cuspidatus* Greene, *Leaf. Bot. Observ. Crit.* 2: 6. 1909. **TYPE**: USA. California. [Stanislaus or Tuolumne Co.] [protologue: "wet shades among rocks along the upper Stanislaus River, ... late June, 1889," *E.L. Greene s.n.* (holotype: NG-Greene! photo-PH!; isotype: DS digital image!). The ND-Greene sheet has no label but is marked in Greene's hand as "Type!"]

*Mimulus erosus* Greene, *Leaf. Bot. Observ. Crit.* 2: 4. 1909. **TYPE**: MEXICO. Baja California. Santa Agueda, 4 Mar 1890, *E. Palmer 233* (holotype: US digital image! photo-PH!).

*Mimulus bakeri* Gandoger, *Bull. Soc. Bot. Fr.* 66: 219. 1919. **LECTOTYPE** (designated here): USA. California. Napa Co.: Mt. St. Helena, colonies common among streamlets, 20 Apr 1903, *C.F. Baker 2608* (CAS digital image!; islectotypes: LY?, ND-Greene!, NY digital image!). Gandoger also cited "Amer. occid. Oregon (*Cusick n. 1627*)." Regarding his set of four new



species, *M. bakeri*, *M. puncticalyx*, *M. parishii*, and *M. puberulus*, Gandoger noted that "Sequentes e polymorpha *Mimulo nasuto* Greene desumptae sunt." Two sheets at UC are labeled "Eastern Oregon Plants, wet rocks, not rare, 15 Jun 1897, *W.C. Cusick* 1627" thus they apparently are not duplicates of the holotype nor do they match the protologue, even though Cusick's collection number is the same.

*Mimulus parishii* Gandoger, Bull. Soc. Bot. Fr. 66: 219. 1919 [non Greene 1885]. TYPE: USA. California. [San Bernardino Co.:] "California ad S. Bernardino," *S.B. Parish* 4741 (holotype: LY?). A possible isotype is at MO: San Bernardino Co.: Vicinity of San Bernardino, 1000-2500 ft, Apr 1897, *S.B. Parish* s.n. (MO!).

*Mimulus puberulus* Gandoger, Bull. Soc. Bot. Fr. 66: 219. 1919 [non Greene ex Rydb. 1906]. TYPE: USA. Washington. Klickitat Co.: Bingen, riverbank, 17 Apr 1905, *W.N. Suksdorf* 5016 (holotype: LY?; isotypes: US digital image!, WS photo-PH!). The WS sheet was photographed at the 'home of W.N. Suksdorf.'

*Mimulus puncticalyx* Gandoger, Bull. Soc. Bot. Fr. 66: 219. 1919. TYPE: USA. Washington. [Klickitat Co.:] Ad Bingen, no date, *W.N. Suksdorf* 2775 (holotype: LY?; isotypes: PH-2 sheets!, WS photo-PH!).

**Annual**, fibrous-rooted or slender taprooted. **Stems** erect to ascending-erect or decumbent, 2–35(–100) cm, usually 4-angled or sometimes shallowly 4-winged, usually thin-wiry but sometimes fistulose, simple or branched from proximal nodes, glabrous except for a consistently small, villous-glandular area just above the nodes, sometimes hirtellous distally. **Leaves** basal and cauline or basal absent at flowering, proximal to medial petiolate, sessile distally, petioles 3–35 mm, narrowly flanged at the base, blades elliptic-ovate to broadly ovate, suborbicular, or depressed ovate, (5–)10–49(–80) mm x (3–)10–25(–60) mm, palmately 3–5-nerved, proximal largest and persistent, apices acute to obtuse, bases cuneate to truncate or subcordate, margins irregularly dentate to dentate-serrate or nearly lacerate-dentate, commonly doubly toothed, 4–9 main teeth per side, sometimes sublacerate to sublyrate basally, more or less tinged with red on the lower surface or purple-spotted, glabrous or often hirtellous on one or both surfaces with dull, terete, sharp-pointed, eglandular hairs. **Flowers** (1–)2–12(–20), usually from distal nodes but sometimes from medial to distal. **Fruiting pedicels** (3–)7–20(–40) mm, glandular-villous on upper side at the axils, otherwise nearly glabrous. **Fruiting calyces** ovoid-campanulate, (5–)10–15(–19) mm, nodding 30°–180°, closing, upper lobe prominently elongate 1.5–3 x beyond the lower and nose-like, glabrous to minutely hirtellous or appressed-hirtellous, minutely short-ciliate at the sinuses, frequently purple-tinged or purple-spotted. **Corollas** yellow, usually with a red-spotted throat and a red blotch at the base of the lower lip, tube-throats broadly cylindric, (5–)8–12 mm, exerted (0–)1–2 mm beyond calyx margin, limb weakly bilabiate, expanded ca. 6–12 mm (pressed). **Styles** minutely scabrous to glabrous. **Plesiogamous**; anther pairs and stigma at the same level. **Capsules** (4–)5–9(–10) mm, stipitate, included.  $2n = 28$  (various localities),  $2n = 26$  (California, Tuolumne Co.; New Mexico, Dona Ana Co.: San Augustine Pass, 4500 ft, 30 Oct 1946, *Norwell* s.n., Vicky cult. 5018, voucher for  $2n = 26$ , UT).

**Flowering** (Mar–)Apr–Jun(–Jul). Cliff faces, ledges, crevices, and bases, wet rocks in rivers, stream sides, sand bars, mossy seeps, wet clay banks, moist fields, sandy soil, depressions over granite, roadsides; (30–)600–2300(–3200) m; California, Nevada, Oregon, Washington, Idaho, Arizona, New Mexico; Canada (British Columbia); Mexico (Baja California, Sonora). Map 21.

*Erythranthe nasuta* is characterized by its annual duration (fibrous-rooted), 4-angled stems, broadly ovate leaves commonly with irregularly toothed margins, calyces with longish, protruding upper lobe, short corollas (autogamous — chasmogamous or cleistogamous), and glandular vestiture only in the axils. At least the distal and bracteal leaves consistently have hirtellous to hirsutulous adaxial surfaces, even in the smallest of plants. *Erythranthe nasuta* has been abundantly collected in Arizona, particularly in Pima County, where the variability in plant size nearly matches that found in California.

Collections examined from Mexico. **Baja California.** San Juanico (8 mi N), rocky arroyo margin, 8 Mar 1939, *Gentry 4305* (ARIZ). **Sonora.** Canyon of the Rio Magdalena, 12 mi above Imuris, 22 Mar 1934, *Shreve 6565* (ARIZ).

As observed in the introduction, plants of *Erythranthe nasuta* produce flowers that vary significantly in size, even on a single plant. Plants with only the tiny cleistogamous flowers (mature calyces 5–7 mm) are so distinctive that upon encountering what appeared to be a population system of them, with tiny leaves and decumbent to procumbent, filiform stems, I first thought they perhaps represented a distinct species. Here it is tentatively concluded that they are variants within the morphological range of the species. Collections examined. **California.** **Kern Co.:** Greenhorn Mts., ca. 2 mi from Alta Sierra, along old road from Alta Sierra to Wofford Heights, 18 May 1976, *Howell 51729* (MO); Greenhorn Range, 2.4 mi W of Wofford, mossy seep, 4300 ft, with *Juncus kelloggii*, etc. 12 May 1969, *Howell and True 455864* (MO). **Kings/Kern Co.:** Mt. Stanford, wet ground, Jul 1890, *Sonne 263* (MO). **Mono Co.:** White Mts., along N fork of Cottonwood Creek, 0.1 mi above its confluence with Tres Plumas Creek, 2.8 mi S 88 E of Eva Belle Mine, moist granite crevices facing 20 WSW above creek with *Rosa*, *Artemisia*, and *Holodiscus*, 11 Jul 1987, *Morefield 4603* (MO). **Tulare Co.:** White Chief, Mineral King, 9700 ft, 1 Jul 1966, *Rice 242* (DAV); Cherry Hill Road, 2.1 mi above Dry Creek, chaparral, 5000 ft, dense colony growing on a recently moist sheet of decomposed granite, 2 Aug 1969, *Twisselman 15914* (JEPS, MO).

Similarly, plants of *Erythranthe nasuta* sometimes encountered with thick-fistulose stems up to one meter tall and with very large fruiting calyces (16–19 mm) appear remarkably distinct and might be considered 'gigas' forms reflecting the influence of polyploidy. Regarding his collection 8158 from Madera Co., cited below, Heller (1906, p. 249) made this observation: "growing about large flat granite rocks on the edge of a stream. The plants were large and robust, many of them fully three feet high and much branched. Ordinarily it is of rather low growth." These phenotypically gigas forms, however, appear to grade into the range of variation more characteristic of the species. Representative collections of the "gigas" form. **California.** **Butte Co.:** ca. 2 mi SE of Jarbo Gap, W side of the North Fork of the Feather River, sand bar, near the Poe Power House, 9 Jun 1987, *Ahart 5735* (MO). **Calaveras Co.:** Camp Nine Road, NE of Vallecito, 1100–2000 ft, 5 Apr 1978, *Howell 52778* (VDB). **Madera Co.:** hills about 5 mi above Pollasky, 12 Apr 1906, *Heller 8158* (MO). **Napa Co.:** Mt. St. Helena, colonies common along streamlets, 20 Apr 1903, *Baker 2608* (LL, MO). **Sonoma Co.:** on a wet bank in clay soil in Knight's Valley, upper Sonoran Life Zone, 20 Apr 1940, *Heller 15545* (MO). **Ventura Co.:** North Fork Ventura River, wet rocks, 750 m, 2 May 1935, *Clokey 6916* (MO).

### *Erythranthe nasuta* and *E. guttata*.

A number of evolutionary studies have focused on differentiation and isolation between outcrossing *Erythranthe guttata* and self-fertilizing *E. nasuta*, but whether the plants involved were identified by the same criteria as in the present study is not known. Mating system and pollen–pistil interactions are said to cause most of the isolation between the two (Kiang & Hamrick, 1978; Diaz & Macnair, 1999; Martin & Willis 2007). Sweigart et al. (2006) found that one incompatibility allele (at hms2) appears to be widespread and perhaps fixed throughout the geographic range of *E. nasuta*. Another allele (hms1) is restricted to some Oregon populations (Linn Co.) of *E. guttata* (the identity ambiguous by reference to the present study).

Fishman et al. (2002) identified in *Erythranthe nasuta* more than 20 loci of small to moderate effects underlying species differences in floral morphology related to mating system divergence. Most of those loci appeared to influence variation in aspects of floral size and shape.

Several populations of small-flowered, autogamous tetraploids that resemble *Erythranthe nasuta* were discovered on Vancouver Island and the Gulf Islands of southwestern Canada as well as in southwestern Oregon (Benedict 1986). On Vancouver Island these plants were growing sympatrically with diploid *E. nasuta* and diploid "*Mimulus guttatus*" (as identified in the study) and Benedict hypothesized that these two species were the parents of the tetraploid. Sweigart et al. (2008) extended the study and found the tetraploid to be "widespread and common from northern California to British Columbia." Fixed heterozygosity at allozyme loci was further evidence for Benedict of an allopoloid origin for the tetraploids, and patterns of molecular variation supported the hypothesis that they were two independent allopoloid origins of the tetraploids (Sweigart et al. 2008).

Two distinct haplotypes occur at each of the nuclear genes *mCYCA* and *mAP3* in each of the tetraploids (Sweigart et al. 2008). One haplotype shares near-identity with sequences from *M. nasutus*; the second is similar to but does not exactly match any members of the *M. guttatus* complex sampled by Sweigart et al. Populations of the tetraploid commonly have individuals with "*M. nasutus*-like haplotypes" mixed with those of "*M. guttatus*-like haplotypes."

The tetraploids resemble *Mimulus nasutus* at least in being annual, small-flowered obligate selfers. As noted by Benedict (p. 122), they are "Very similar to *M. nasutus*. All characters overlap to a degree with *M. nasutus* but, under favorable growth conditions, the following structures tend to be more enlarged in *M. nasutus*: [height, stem width, calyx length, leaves, pedicel length, stipe length]." Benedict and Sweigart et al. found that the tetraploids are nearly completely reproductively isolated from their putative parents — *E. nasuta* and some expression of *E. guttata* in the broad sense. Benedict provided the following key couplet.

- |  |                               |
|--|-------------------------------|
| 1. Pistil included within or equal to calyx, corolla tube-throat nearly cylindrical, plants 5–50 cm tall, large ones with quadrangular winged stem; diploid                                  | <b><i>Mimulus nasutus</i></b> |
| 1. Pistil usually exserted from calyx (up to 3 mm), corolla tube-throat narrowly funnel-shaped (infundibular); plants 5–25 cm tall, stems tending to quadrangular but not winged, tetraploid | <b><i>Mimulus</i> sp.</b>     |

The species identified in these studies as *Mimulus guttatus* perhaps is *Erythranthe microphylla* as identified in the present account, as Benedict indicated that these plants are annual, which excludes *E. guttata* in the present sense. On the other hand, she referred to *Mimulus platycalyx* (here placed as a synonym of *E. microphylla*) and distinguished it from "annual *Mimulus guttatus*," even noting that she found "*Mimulus platycalyx*" growing close to populations of the tetraploid in Oregon. An understanding of the biology and taxonomy in this situation remains incomplete.

The tetraploid has not been distinguished in the current study (with one possible exception, below), but I have examined relatively little material from Oregon and Washington, and it is possible that I simply overlooked the variants before becoming aware of the differences noted by Benedict, which is the only place its morphology has been characterized.

I have examined one collection from northern Oregon that perhaps are similar in origin to the tetraploids above. Multnomah Co.: Base of Multnomah Falls in damp area, 280 ft, 22 Aug 1969, McArthur 33, Vickery cult. 9562, voucher for  $n = 28$  (UT). These plants have erect stems apparently from a rhizomatous base, the stems, pedicels, calyces, and leaves are minutely hirtellous and eglandular, the fruiting calyces are 8–11 mm long and apparently not closing, and the corollas are light yellow with a dark yellow palate, sparsely spotted throat, and tubes 10–12 mm long, little at all exserted beyond the calyx margin. If the rhizomatous morphology and tetraploid chromosome number within this population are correct as observed and consistent, it would justifiably be treated as a distinct species (a previously undescribed one, and different from the plants discussed by Benedict).

The chromosome number was reported by McArthur et al. (1972), who identified it as *Mimulus guttatus*, but the tiny, autogamous flowers immediately remove it from that species.

24. **ERYTHRANTHE LACINIATA** (A. Gray) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus laciniatus* A. Gray, Proc. Amer. Acad. Arts 11: 98. 1876 [January]. TYPE: USA. California. [Mariposa Co.]: On the South Fork of the Merced at Clark's Ranch, 1872, C. Sullivan and A. Gray s.n. (holotype: GH).

*Mimulus eisenii* Kellogg, Proc. Calif. Acad. Sci., ser. 1, 7: 89. 1876 [August or later]. TYPE: USA. California. [Fresno Co.]: Near Fresno, no date, Dr. G. Eisen s.n. (holotype: CAS digital image! photo-PH!, fragment UC!).

**Annual**, slender taprooted or fibrous-rooted. **Stems** erect, 3–38 cm, simple or branched from the base, glabrous to sparsely hirtellous, finely villousulous glandular above the nodes but not elsewhere. **Leaves** cauline, basal deciduous by flowering, blades elliptic to elliptic-obovate, oblanceolate, or oblong, 3–55 mm, margins commonly narrowly pinnately lobed or dissected, sometimes merely shallowly toothed, all petiolate or distally subsessile, petioles absent or 1–35 mm. **Flowers** 2–8, from medial to distal nodes. **Fruiting pedicels** 5–25 mm, nodding 30°–140° at the calyx base. **Fruiting calyces** cylindric-campanulate, 8–10 mm, closing, red-spotted ± glabrous, upper lobe slightly longer than the others. **Corollas** yellow, red-spotted in the throat and the larger usually with a single large red blotch on the lower lip, tube-throats 4–6 mm, exerted 1–2 beyond the calyx margin, limb weakly to strongly bilabiate, expanded ca. 5–6 mm (pressed). **Styles** glabrous. **Plesiomorous**; anther pairs and stigma at the same level. **Capsules** 5–7 mm, stipitate, included.  $2n = 28$ .

Flowering Apr–Jul(–Aug). Cracks, depressions, and seeps in granite outcrops, ledges, talus and scree, rocky stream sides, rocky slopes, roadsides, intermittent drainages; 900–2300(–2900, –3300) m; California (Amador, Butte, Fresno, Madera, Mariposa, Tulare, Tuolumne cos.). Map 18.

As in *Erythranthe nasuta*, the upper calyx lobe in *E. laciniata* tends to be narrowly lanceolate to triangular (nose-like) and perceptibly falcate, curving slightly upward both in flower and in fruit. The upper lobe is not so prominently protrusive as it often is in *E. nasuta*.

Corollas size is variable in *Erythranthe laciniata* but size of those with open throats (vs. much reduced in size and apparently cleistogamous) is not strongly correlated with size of the individual plant. Those on some plants, however, are all or nearly all greatly reduced and apparently cleistogamous. Even the larger corollas apparently are autogamous — the anther pairs are slightly separated or equal in level and the stigma is in the middle of the anthers or at the level of the upper pair.

Plants from Butte County identified here as *Erythranthe laciniata* are disjunct from the main range and have much larger and more highly dissected leaves.

25. **ERYTHRANTHE PARDALIS** (Pennell) Nesom, Phytoneuron 2012-40: 44. 2012. *Mimulus pardalis* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 164. 1947. TYPE: USA. California. Tuolumne Co.: Red Hills above Peoria Flat, crevices of serpentine rock, 1600 ft, 11–16 Apr 1919, R.S. Ferris 1602 (holotype: DS digital image!; isotypes: JEPS, PH!, POM).

*Mimulus cupriphilus* M. Macnair, Bot. J. Linn. Soc. 100: 3. 1989. TYPE: USA. California. Calaveras Co.: McNulty mine, copper-contaminated soil, "April 13–20th 1987," M. McNair s.n. (holotype: BM as cited; isotype: JEPS as cited in the protologue but not located at JEPS). Macnair perhaps intended the JEPS specimen cited below (identified by Macnair as *M. cupriphilus*) as an isotype but it is not a duplicate of the cited holotype. In any case, the Macnair collection at JEPS is unequivocally identified as *Erythranthe pardalis*.

**Annual**, fibrous-rooted or taprooted; stems, calyx, and pedicels short and delicately stipitate-glandular; distal stems and pedicels minutely puberulent-glandular with gland-tipped hairs 0.1–0.4 mm (to 1 mm on proximal portions of stems). **Stems** decumbent-ascending with distal portion erect, 5–30 cm, simple or sometimes branched from proximal to medial nodes. **Leaves** mostly cauline, basal usually absent at flowering, all petiolate or distal-most becoming subsessile, proximal and medial petioles 8–20 mm, distal 1–2 mm, blades mostly ovate or broadly ovate to depressed-ovate, palmately 3-veined, proximal and medial 7–22 mm × 6–18 mm, sometimes largest at midstem, sparsely villous to puberulent-glandular with vitreous, gland-tipped hairs, less commonly glabrous, apices obtuse to obtuse-acuminate, margins shallowly dentate-serrate with 2–3(–5) teeth per side, mostly distally, bases rounded or cuneate to a gradually attenuate petioles 1–12 mm. **Flowers** 2–12, usually evenly distributed from proximal to distal nodes. **Fruiting pedicels** 10–35 mm. **Fruiting calyces** cylindric-campanulate, 8–11 mm, nodding 45°–180°, consistently dark purple-spotted, glabrous to sparsely puberulent-glandular, sometimes minutely hirtellous, lobes triangular-acute, uppermost longest, lower two closing upward against the upper. **Corollas** yellow, without prominent red spots or sometimes sparsely red-spotted on floor of throat, tube-throats narrowly funnelliform to cylindric, 7–10(–12) mm, exserted 1–3 mm beyond calyx margin, limb bilabiate, expanded 8–12 mm (pressed), palate villous. **Styles** glabrous. **Plesiogamous**; anther pairs in larger corollas slightly separated and stigma at level of upper pair or both anther pairs and stigma at the same level; in smaller corollas (without expanded limb and barely exserted beyond calyx margin) both anther pairs and stigma at the same level. **Capsules** 4–6 mm, stipitate, included.  $2n = 28$ .

Flowering (Mar–)Apr–May. Crevices of serpentine rock, stony red soils, red clay, among boulders, along streams, ditches, tailings at copper mines; 100–700 m. California (Amador, Calaveras, El Dorado, Placer, Tehama, Tuolumne cos.). Map 19.

*Erythranthe pardalis* (Fig. 8) is recognized by its annual duration (fibrous-rooted or taprooted) and relatively delicate habit, ovate to depressed-ovate leaves toothed mostly on the distal margins, small, autogamous flowers produced from all nodes (proximal to distal), dark-spotted calyces, and glandular cauline and foliar vestiture. The plants occur primarily on serpentine rocks and soil but also grow on copper tailings at mine sites. The plants in Tehama County, disjunct from the main range, perhaps are not on serpentine.

*Mimulus cupriphilus* was viewed by McNair (1989; McNair et al. 1989; McNair & Cumbs 1989) as a narrow endemic restricted to copper-contaminated substrates — he knew it only from three populations at two closely situated copper mines near Copperopolis in Calaveras County and was unable to find it on nearby copper outcrops or mine sites. He hypothesized that *M. cupriphilus* is an immediate derivative of *M. guttatus* — "It is probable that this species [*M. cupriphilus*] evolved on one or both of these copper mines from copper tolerant *M. guttatus*" (McNair & Cumbs 1989, p. 219). McNair (1989, p. 13) suggested that *M. cupriphilus* probably evolved "within the last 150 years, and most probably within the last 50" — corresponding to the time period in which copper mines in central California were intensively worked.

The reasoning upon which this hypothesis was based is quoted here (McNair & Cumbs 1989, p. 212): "The origin of this form [*Mimulus cupriphilus*] is unknown, but it is not unlikely that it evolved in the recent past close to its present location. It is very improbable that a widespread species could have gone previously undescribed in California. It is possible that it is a rare undescribed species, which evolved a tolerant race only on these two mines: however, rare species are unlikely to evolve tolerance simply because they will not have the genetic resources to do so (McNair, 1987). Also, despite a diligent search of the surrounding area, no nontolerant populations of this form have been found. It is not an unreasonable hypothesis to suggest therefore that this form represents a recent evolutionary event."

It remains possible that populations of *Erythranthe pardalis* on copper substrate are physiologically specialized from the more widespread serpentine plants (though the same gene may not be responsible for both tolerances (e.g., McNair & Smith 1987). The "copper" populations of *E. cupriphila*, however, appear to utilize the same gene (genetic locus) for copper tolerance as the local copper tolerant populations of *E. guttata*, an observation emphasized by McNair and Cumbs in their speculative scenario for the evolutionary derivation of *Mimulus cupriphilus*. In view of the broader perspective of species relationships hypothesized here, however, the hypothesis that *E. pardalis* evolved directly from *E. guttata* was in part a correlate of the absence of taxonomic perspective. And given the discovery that *Mimulus cupriphilus* is a synonym of *Mimulus pardalis*, there is no reason to believe that the evolutionary age of this species differs significantly from its relatives.



Figure 8. *Erythranthe pardalis*. Isotype DS

Using progeny from experimentally produced reciprocal crosses and backcrosses between *Mimulus guttatus* and *M. cupriphilus*, McNair and Cumbs (1989) studied genetic systems governing flowering time, floral morphology, plant size, and duration. The observation by McNair of putative natural *cupriphilus-guttatus* hybrids at one site needs to be confirmed and, if confirmed, documented, as only anecdotal observation was provided.

*Erythranthe pardalis* and its putative close relative *E. nasuta* occur sympatrically and it is possible that some plants in Tuolumne and Calaveras counties might even be *pardalis*-*nasuta* hybrids, but they produce the tiny flowers on short stems from basal nodes that are characteristic of *E. nasuta* but not *E. pardalis*: e.g., Calaveras Co.: Heckard 5507 (UC) and Robbins 3524 (UC); Tuolumne Co.: Ferris 1626 (UC) and Hoover 1336 (UC).

Additional collections examined. **California.** **Amador Co.:** Jackson, 1892, *Hansen s.n.* (ND-Greene); Silver Lake, 20 Sep 1892, *Hansen s.n.* (ND-Greene); Middle Fork, 1500 ft, Apr 1893, *Hansen 135* (MO); Fisher's Cabin, 2000 ft, Apr 1892, *Hansen 473* (MO, ND-Greene, UC); New York Falls, 2000 ft, Apr 1892, *Hansen 1286* (MO, UC); Middle Fork, 1500 ft, Apr 1892, *Hansen 1288* (MO); Ione, 300 ft, 25 Mar 1896, *Hansen 1517* (MO, ND-Greene); Elsie's Creek, 2700 ft, May 1896, *Hansen 1626* (ND-Greene); N of Falls, 2000 ft, 18 Jul 1896, *Hansen 1795* (ND-Greene); N face of steep canyon and rocky places near stream, in foothill woodland, in red clay, 4 mi E of Plymouth, on road to Fiddletown, 30 Mar 1961, *Ramsey 29* (JEPS-2 sheets). **Calaveras Co.:** Table Top Mt., SE face, 700 ft, Copperopolis Quad, 16 Apr 1936, *Belshaw 1896* (UC); 5 mi NE of Valley Springs on road to Fosteria, in moist ditch on slope with *Pinus sabiniana*, 3 May 1963, *Breedlove 4788* (SMU); Pardee Reservoir, Pardee Lake, W of McAfee gulch at S end of the gulch, W of the Coast to Crest Trail just before it heads down into the gulch, burned ca. 5 years ago, 1032 ft, 17 May 2005, *CNPS SN Foothill Team SNFN0249b* (DAV); Table Mt., 7 mi S of Copperopolis on road to State Hwys 108 and 120, on top of old lava flow, 1100 ft, 27 Apr 1963, *Lloyd 2444* (JEPS); McNulty Mine, copper-contaminated stream, [greenhouse grown], "seeds collected from dead plants, May 1985; plants grown August 1986," *McNair s.n.* (JEPS); ca. 7 air mi SW of Copperopolis, Star & Excelsior Mine, tailings pile from copper mine, 800 ft, 7 Apr 1998, *Taylor 16283* (JEPS), *16285* (JEPS-2 sheets), and *16286* (JEPS-2 sheets). **El Dorado Co.:** 2 mi NW of Clarksville, SE slope of Bass Lake, under and along edge of serpentine rocks, 5 May 1967, *Crampton 7859* (AHUC); near San Andreas, 24 Apr 1941, *Eastwood and Howell 8710* (UC); along Rose Creek at its mouth on the Stanislaus River, 12 Apr 1981, *Heckard 5505* (JEPS); along Stanislaus River (E side), ca. 3 air mi NNW of Columbia, ca. 880 ft, 12 Apr 1981, *Heckard 5507* (JEPS). **Placer Co.:** Iowa Creek Road ca. 2 mi from I-80 near entrance to Auburn State Recreation Area, at creek crossing, ca. 1700 ft, boulders at base of open S-facing slope, only at edge of boulder, herbage ± slimy, 8 Apr 1989, *Ertter 8173* (MO, TEX, UC). **Tehama Co.:** Dales Lake Ecological Reserve, W side of Manton Rd (A6) ca. 2 mi N of Dales Station on Hwy 36, ca. 14 mi NE of Red Bluff, localized population in crevices on a shaded outcrop on the S edge of the basal ridge crossing the NE corner of the reservoir, blue oak woodland, 740 ft, 10 Apr 1995, *Oswald & Ahart 6642* (JEPS). **Tuolumne Co.:** 1.8 mi N of the Tuolumne-Mariposa county line, moist rocky serpentine soil along the large rock outcrops above Hwy 49, 19 Mar 1974, *McNeal 1383* (UT); Red Hills area, W of Chinese Camp, along Minnow Gulch, moist crevices of ultrabasic rock, 1000 ft, 8 Apr 1973, *Stebbins 9033* and *9039* (JEPS); Peoria Pass, Peoria Pass Road, 2.5 road mi N of Hwy 120, low relief serpentine hills E from the roadway, deep red, weathered serpentine clay in open *Ceanothus cuneatus* chaparral burned the previous summer, 26 Mar 1998, *Taylor 16268* (JEPS-2 sheets); Peoria Basin, slopes at SE edge of basin ca. 1 mi E of Peoria Pass Rd, stony red weathered serpentine soils dominated by *Ceanothus cuneatus* chaparral, 900 ft, 15 Apr 1998, *Taylor 16328* (UC); Stanislaus River 2 mi downstream from Tulloch Lake dam, shaded northerly slopes at base of Table Mt., in stony red soils dominated by *Quercus douglasii*-*Aesculus californica*, 490 ft, 15 Apr 1998, *Taylor 16313* (MO, UC).

26. **ERYTHRANTHE BREVINASUTA** Nesom, sp. nov. TYPE: MEXICO. Baja California Sur. Sierra Guadalupe, W of Mulege, S of Rancho San Sebastian, near Ranchos San Fernando, El Cochi, Guaribo, and San Andrés, 26° 59' 20" N, 112° 27' 33" W, volcanic slopes and canyon, *Lysitoma divaricata*, ca. 900 m, 27 Oct 1997, J.P. Rebman 4592 (holotype: SD!).

Similar to *Erythranthe nasuta* in its flowers produced from basal to distal nodes, small corollas and autogamous flowers, relatively broad leaf blades with irregularly serrate margins, hirtellous vestiture of bracteal leaves, pedicels sparsely glandular-villous just above the nodes; different in its terete stems, short upper calyx lobe and tendency for tiny teeth on the calyx lobes, denticulate corolla lobes, stems decumbent-ascending to ascending from the base, lack of basal branches that produce tiny cleistogamous flowers, and southern distribution disjunct from the range of *E. nasuta*.

**Annual herbs**, fibrous-rooted. **Stems** decumbent-ascending to ascending from the base, sometimes rooting a lower nodes, 6–30 cm, thin to thickened, simple or branched from proximal nodes, glabrous except for a small glandular-villous area on the pedicels just above the nodes. **Leaves** cauline, basal absent by flowering, largest proximally, gradually reduced in size distally, proximal petiolate, petioles 5–20 mm, distal sessile, basal to medial blades ovate to elliptic-ovate or depressed ovate, 10–45 mm x 12–40 mm, palmately 3–5 veined, margins irregularly serrate-dentate, usually doubly toothed with 3–6 main teeth per side, uppermost bracts usually sparsely to densely hirtellous on both surfaces, other leaves glabrous. **Flowers** 3–15, from medial to distal nodes or sometimes from proximal to distal. **Fruiting pedicels** 7–30 mm, sparsely villous-glandular just above the nodes, otherwise glabrous. **Fruiting calyces** ovoid-campanulate, 7–9 mm, nodding 45–90°, closing, upper lobe slightly longer, not nose-like, glabrous or less commonly minutely hirtellous, margins prominently villous at the sinuses, usually sparsely purple-dotted, upper lobe commonly with a pair of distal, shallowly dentate teeth. **Corollas** yellow, red-dotted in throat, usually with a larger red splotch on the lower lip, tube-throats narrowly funnelliform, 8–10 mm, exserted 3–5 mm beyond the calyx margin, limb weakly bilabiate, expanded 4–7 mm (pressed), each lateral lobe margin with 1–3 shallow denticles or apiculae. **Styles** glabrous. **Plesiogamous**. **Capsules** 4–5 mm, stipitate.

Flowering (Oct–)Dec–Mar. Volcanic slopes and canyon bottoms, sandy stream and pond edges, seepy slopes; 30–900 m; Mexico (Baja California, Baja California Sur). Map 12.

Additional collections examined. **MEXICO. Baja California.** Arroyo San Pedro, near San Pedro, occasional in wet sand, ca. 350 m, 28° 30' N, 113° 30' W, 11 Mar 1966, *Moran 12525* (SD). **Baja California Sur.** Canyon below La Victoria, W of Notri, 25° 52.5' N, 111° 25' W, small hanging valley, 540 m, 21 Mar 1960, *Carter 3929* with Ferris (SD); [Mpio. Loreto], 15 mi SSW of San Javier, Arroyo Santo Domingo, along stream bed of Arroyo Santo Domingo, 29 Mar 1970, *Crutchfield & Turner 3639* (TEX); Sierra Giganta, Arroyo Hondo [N of Cerro Giganta], riparian in canyon bottom, 14 Dec 1938, *Gentry 4138* (ARIZ); 8 mi N of San Juanico, rocky arroyo margin, 8 Mar 1939, *Gentry 4305* (ARIZ); Arroyo San Juan, 26° 26' N, 112° 44' W, ca. 30 m, by seepage-fed pond (with ducks), 14 Feb 1973, *Moran 20115* (SD).

These plants might be treated as a geographic outlyer within *Erythranthe nasuta*, but their formal segregation here emphasizes the differences in stem and corolla morphology and stem orientation. Also, the tendency to produce calyx lobes with toothed margins suggests that *E. brevinasuta* may share genetic background with the even more southern *E. lagunensis*. Lack of a prominent "beaked" calyx also is a distinctive difference, but there is variability in this feature within the range of typical *E. nasuta*. The choice of epithet is intended to point to the short calyx beak while alluding to the possible close relationship of the two species, although it perhaps is likely that *E. brevinasuta* is closer to *E. lagunensis* and thence to *E. guttata*.



The terete stems of *Erythranthe brevinasuta* contrast sharply with those of *E. nasuta*. The latter has 4-angled stems (to narrowly 4-winged on thicker stems) — a distinctive and consistent diagnostic feature in combination with the cleistogamous flowers, annual duration, and characteristic leaf shape and vestiture. Even on the smallest plants of *E. nasuta*, the 4-angled morphology can be seen by looking just above the nodes.

The shallowly denticulate corolla margins of *Erythranthe brevinasuta* suggest that the species might share ancestry with *E. dentiloba* and its relatives, since this feature is not encountered elsewhere in the genus, but the overall morphology is much more similar to *E. nasuta*.

27. **ERYTHRANTHE ARVENSIS** (Greene) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus arvensis* Greene, Pittonia 1: 37. 1887. *Mimulus langsdorffii* var. *arvensis* (Greene) Jepson, Fl. W. Mid. Calif., 407. 1901. *Mimulus guttatus* var. *arvensis* (Greene) Grant, Ann. Missouri Bot. Gard. 11: 174. 1924. *Mimulus guttatus* subsp. *arvensis* (Greene) Munz, Aliso 4: 99. 1958. **LECTOTYPE** (designated here): USA. California. [San Mateo Co.] Belmont, May 1886, *E.L. Greene s.n.* (ND-Greene! photo-PH!; isoelectotypes: PH 2 sheets!).

In the protologue, Greene noted that "This plant was first known to me in a specimen or two brought from Lake County in 1884 by Mrs. Curran. I have mentioned it on page 112 of the first volume of California Academy Bulletin, under *M. microphyllus*. In the spring of 1886 I was surprised to find it common in wheat fields among the growing grain, in both San Mateo and Marin counties, not far from San Francisco. It is strictly annual and very unlike the common *M. guttatus* to which, under the name of *M. luteus*, a large number of our species and subspecies were until recently referred. In the districts named the large perennial will be met with in the same field with the annual, if a streamlet or springy place exist; and this not rarely 5 feet high, bearing a truly magnificent panicle of racemes, sometimes the whole cluster nearly 2 feet long, and half as broad; and the annual here defined will be in seed and dying while its neighbor of the streamlets is not yet in full flower toward the end of April."

In addition to the collection from San Mateo Co, there is another relevant sheet at PH: California. [Marin Co.:] Pt. Reyes, 15 Apr 1886, *E.L. Greene s.n.* (PH!). Each of the three sheets has a label with handwritten identification by Greene as "*Mimulus arvensis* Greene." The PH sheets from Belmont were annotated by Pennell as isotypes of *M. arvensis*.

In the protologue Greene speculated that *Mimulus arvensis* might be the same as *M. lyratus*. Both taxa were treated as distinct species by Pennell (1951); Grant (1924) treated *M. arvensis* as *M. guttatus* var. *arvensis* but *M. lyratus* as a synonym of typical *M. guttatus*. *Mimulus lyratus* is regarded here as a synonym of *M. guttatus*.

- Mimulus longulus* Greene, Leaf. Bot. Observ. Crit. 2: 4. 1909. **LECTOTYPE** (designated here): USA. Nevada. [Elko Co.:] Deeth, in low meadows along the Humboldt River, [protologue: "margins of spring pools that in summer have gone dry,"] 26 Jul 1896, *E.L. Greene s.n.* (ND-Greene 46314!, photo-PH!; isoelectotype: NG-Greene!). "The species can only be compared with my *M. Hallii* of Colorado; and that is low, with rather crowded leaves and flowers; has also a calyx with much more unequal teeth and these closely connivent." Treated as a distinct species by Pennell (1951), who noted that it occurs on the "Columbia Plateau of eastern Washington and Oregon eastward and southward to Montana, Utah, and Arizona." The bracts have little or no villous vestiture.

- Mimulus micranthus* Heller, Muhlenbergia 8: 132. 1912. *Mimulus nasutus* Greene var. *micranthus* (Heller) A.L. Grant, Ann. Missouri Bot. Gard. 11: 182. 1924. *Mimulus guttatus* var. *micranthus* (Heller) G.R. Campbell, Aliso 2: 332. 1950. *Mimulus guttatus* subsp. *micranthus* (Heller) Munz, Aliso 4: 99. 1958. **TYPE**: USA. California. Santa Clara Co.: Twenty-seven Mile Drive near Congress Springs, 13 May 1904, *A.A. Heller 7410* (holotype: BKL?; isotypes: CAS digital image!, MO!, MSC, NY digital image!, PH!, UC!, US digital image!).

*Mimulus hallii* var. *alvordensis* Pennell ex Peck, Man. Pl. Oregon, 655. 1941. TYPE: USA. Oregon. [Harney Co.: Alvord Ranch, lower flanks of Steins Mts., 2 Jul 1927, L.F. Henderson 7129 (holotype: PH)]. Annotated by Pennell in 1945 as "TYPE" of var. *alvordensis* then in 1939 as "*Mimulus longulus* Greene." The protologue gives only this: "Wet, somewhat alkaline soil, Harney and Malheur cos."

**Annual**, taprooted or fibrous-rooted, sometimes rooting at proximal cauline nodes if decumbent. **Stems** erect to decumbent-ascending, 5–70 cm, simple or branched from proximal to medial nodes, usually 4-angled, fistulose to very narrow, glabrous or sometimes minutely hirtellous in the inflorescence with deflexed hairs, eglandular. **Leaves** basal and cauline or basal absent by flowering, often largest at midstem or above, reduced in size distally, blades ovate to orbicular, orbicular-ovate, oblong-ovate, or (middle and upper cauline) depressed-ovate to nearly reniform, (5–)10–35(–45) mm x 6–26(–50) mm, palmately 3–5-veined, glabrous except for bracts densely villous abaxially or sometimes on both surfaces with vitreous eglandular hairs (completely glabrous in Baja California), margins denticulate or subentire to distinctly dentate, on larger plants the proximal characteristically lacerate-lobed to pinnatifid at the margin base, apex rounded, base rounded to truncate, subcordate, or shallowly cordate, distal broadly orbicular to depressed-ovate, sessile, petioles 3–20(–90) mm. **Flowers** 3–8(–16), from remote distal nodes. **Fruiting pedicels** 5–40(–90) mm, glabrous. **Fruiting calyces** ovate-campanulate, (7–)9–14, lobes turning up and closing the throat or not and the throat remaining open, with or without red dots, faces minutely hirtellous. **Corollas** yellow, usually red-spotted, tube-throats cylindric-funnelform, (7–)8–12 mm, exerted (0–)1–2(–)3 mm beyond calyx margin, limb weakly bilabiate to subcylindric and nearly regular, expanded 5–10 mm (pressed). **Styles** glabrous. **Plesiomorphic**; anther pairs not separated in level, stigma at the same level. **Capsules** (5–)6–7 mm, stipitate, included.  $2n = 28$ .

Flowering Apr–Jun(–Jul). Hills, ridges, clay banks, stream banks, moist woods; 30–1900(–2300 in Nevada) m; California, Nevada, Oregon; Mexico (Baja California). Map 15.

Additional collections examined. **MEXICO. Baja California.** 2 km SE of El Chocolate, 31° 30.5' N, 116° 23.5' W, local in wet soil, 275 m, 11 Mar 1979, *Moran 26692* (SD); Sierra La Asamblea, NE of El Cruero (jet of Hwy 1 and road to Bahía de Los Angeles), riparian zone in the vicinity of Rancho San Luis, 29° 16' 35" N, 114° 02' 41" W, Vizcaino desert, 1000 m, 20 Apr 2004, *Rebman 9872* (SD); Sierra La Libertad, vicinity of the abandoned Rancho El Paraiso, along the riparian area of Arroyo El Paraiso, 28.5424° N, 113.631° W, Sonoran desert, 745 m, 25 Apr 2009, *Rebman 17265* (SD); Canyon del Diabolo, E slope of Sierra San Pedro Martir, reached via Santa Clara, 4200 ft, 31 Mar 1973, *Taylor 2306* (UC). **CANADA. British Columbia.** [Chilliwack-Fraser Canyon Co.: Aspen Grove along edge of shallow lake in rich humus, 3500 ft, 26 Jun 1934, *Went 43* (UC). **USA. California.** *Alameda Co.*: Berkeley, Apr 1893, *Michener & Bioletti s.n.* (ND-Greene); "Boswell's" damp rocky places, 300 ft, 10 Feb 1900, *Tracy 513* (TEX). *Humboldt Co.*: Alder Point on Eel River, shady wet ground around spring, 500 ft, corolla yellow, not spotted, 22 May 1903, *Tracy 1883* (TEX); 2 mi N of Laytonville, moist clay bank in shade, 7 Jun 1937, *Heller 15892* (MO); Alton, 100–300 ft, 9 Jun 1912, *Tracy 3688* (MO). *Lake Co.*: Hough's Springs, 7 May 1928, *Abrams 12530* (MO). *Marin Co.*: Tiburon, Jun 1886, *Greene s.n.* (ND-Greene); *Mendocino Co.*: N of Caho Peak ca 5 air miles W of Laytonville, Stoten Opening at head of Elder Creek on W side of Signal Peak, moist ground along streamlet, ca. 3800 ft, fls yellow, appearing cleistogamous, 14 May 1989, *Erter 8467* (TEX); 6.3 mi E of Dos Rios, along Poonbiury Road between Dos Rios and Covelo, along small stream in wet soil, 28 May 1949, *Wiggins 12145* (SMU, UT). *Modoc Co.*: Davis Creek, Jun 1895, *Austin s.n.* (ND-Greene); *Napa Co.*: hills E of St. Helena, 23 Apr 1915, *Jepson 6238* (UC). *San Mateo Co.*: San Mateo, 21 Apr 1894, *Burnham s.n.* (BH, as cited by Grant 1924). *Santa Clara Co.*: Stanford University, 25 Apr 1902, *Abrams 2370* (MO); foothills near Stanford University, 2 May 1902, *Baker 881* (ND-Greene); Ahviss, 1892, *Bioletti s.n.* (ND-Greene); summit of the first ridge west of Los Gatos, 9 May 1904, *Heller 7393* (MO); Smith Creek, foot of Mt. Hamilton, 10 May 1907, *Heller*

8517 (MO); hills west of Los Gatos, ca. 7000 ft, 30 Apr 1980, *Heller 8936* (MO). Sonoma Co.: near Windsor, 18 Apr 1902, *Heller & Brown s.n.* (MO); Shellville, May 1892, *Michener & Bioletti s.n.* (ND-Greene). Siskiyou Co.: Metcalf's ranch, NE base of Mt. Eddy, open places in the forest, ca. 3800 ft, 20 Jun 1919, *Heller 13256* (MO). Idaho. Bear Lake Co.: Georgetown Canyon, 8 air mi NE of Georgetown, in cold spring water, 13 Jul 1978, *Shultz 2753* (UT). Canyon Co.: Squaw Butte, gravelly wet places, 3500 ft, 29 May 1910, *Macbride 143* (MO). Cassia Co.: Raft River Geothermal Area, 17 mi S of Malta, along lower Cottonwood Creek, 5000 ft, 22 Jun 1976, *Allan 796* (UT); Basin, 7 Jul 1964, *Harper 1157* (UT). Owyhee Co.: Hot Hole, East Fork Bruneau, wet woods, 3 Jul 1912, *Nelson & Macbride 1908* (MO, SMU). Nevada. Elko Co.: Star Canyon, SE of Deeth, 5600 ft, 10 Jul 1912, *Heller 10569* (MO, UC); Jarbridge, by a spring, 7000 ft, 6 Jul 1912, *Nelson & Macbride 1959* (MO, SMU); Route 40, 2-3 miles SE of Deeth, slow-flowing brook in meadow, 5400-5500 ft, 22 Jul 1938, *Pennell and Schaeffer 23430* (PH 2 sheets!). Humboldt Co.: Paradise Valley, NE of Winnemucca, irrigated meadow, 4700 ft, 24 Jun 1967, *Gentry 1633* (UC). White Pine Co.: 2 mi NE of Hamilton, moist spring, 8000 ft, 8 Jul 1946, *McMillan et al. 80* (UT). Oregon. Grant Co.: 3 mi above Prairie, wet sunny places along W Fork of Dixie Creek, 18 Jun 1925, *Henderson 5493* (MO-2 sheets). Harney Co.: damp ground 5 mi N of Wagontire, 22 Jun 1941, *Peck 20858* (UC). Jackson Co.: Queen's Branch, 18 Jun 1892, *Hammond 311* (MO). Klamath Co.: along Hwy 66 ca. 10.5 mi E of Klamath River crossing at Boyles Reservoir, moist to wet meadow area, *Juncus* dominant, bordered by *Pinus ponderosa* forest, ca. 4400 ft, 25 Jun 1995, *Taylor 15134* (UC). Linn Co.: Big Meadows, springy places, 1370 m, 26 Jul 1894, *Leiberg 533* (UC). Utah. Box Elder Co.: Raft River Mts., Dunn Canyon, Middle Fork, moist loam soil in seeps under aspen, frequent, 7000 ft, 31 Jul 1943, *Maguire & Holmgren 22188* (UC). Washington. Stevens Co.: Loon Lake, wet meadows, common, 23 Jun 1903, *Beattie & Chapman 2101* (UC).

*Erythranthe arvensis* is characterized by its annual duration (fibrous-rooted or taprooted) but commonly rooting at proximal cauline nodes, glabrous, fistulose stems with nodes few and remotely spaced, depressed-ovate leaves with margins often sublyrate (lacerate-lobed to subpinnatifid) at the base, distal leaves and bracts densely villous with vitreous eglandular hairs, other leaves (proximally) glabrous, and corollas varying in size from relatively small but perhaps chasmogamous (the type of *Mimulus arvensis*) to even smaller (cleistogamous; the type of *Mimulus micranthus*). The breeding system is consistently autogamous — in larger to smaller corollas.

The plants in Baja California are considerably disjunct from the main range and they are completely glabrous, lacking the vitreous hairs on the bracts. The calyces are consistently open at maturity. More detailed study may show them to be distinct in other ways.

A diagnostic feature of *Mimulus arvensis* has been described as its relatively short and even-sized calyx lobes that do not turn upward to close the orifice, and this commonly is an evident feature. In fact, however, even among collections cited by Grant, some plants have a longer upper calyx lobe and lower lobes that turn upward in variable degrees.

Leaf morphology of *Erythranthe arvensis* often is very similar to that of *E. microphylla* and the two perhaps hybridize. An example of a possible hybrid is this: California. Lake Co.: 27 mi from Montecello, boggy ground along roadside, 25 Apr 1943, *Ensign 337* (DAV). This is a tall plant with racemes on side branches, large, closed fruiting calyces (13–18 mm), densely villous distal bracts, and relatively short corolla tubes (12–14 mm) with the stigma only very slightly above the upper anther pair.

Some plants from the Cosumnes River Preserve in Sacramento Co. (e.g., *PeBenito et al. 31*, *Popp 17na*, DAV) have overall morphology of *Erythranthe arvensis*, including villous bracts, but the corollas are slightly longer than typical and the anther pairs are separated with the stigma at or

slightly above the upper pair. This might reflect genetic influence from typical *E. microphylla*, which occurs in the same area. In Cold Canyon, Solano County, plants (DAY) identified here as *E. arvensis* have hirtellous stems and leaves, perhaps indicating genetic influence of some other species.

A collection from the Stanislaus River shows plants with the vegetative morphology of *Erythranthe arvensis* and with non-closing calyces but the corollas are longer with expanded limbs and the stigma well above both pairs of stamens. A hybrid with *E. guttata* or *E. microphylla*?, but more than a single plant apparently is represented on the two sheets. **California.** Tuolumne/Stanislaus/ San Joaquin Co.: Stanislaus River, [no other locality data,] 17 Jun 1889, *Greene s.n.* (ND-Greene-2 sheets).

A series of plants from southeastern Oregon, may well warrant recognition at specific rank if they further prove to be consistent in morphology. A total of 25 individuals on two sheets have the aspect of *Erythranthe arvensis* but the stems of all are consistently sparsely retrorse-hirtellous. The plants are 2–14 cm tall. **Harney Co.:** 12 mi W of Vale, seepage slope, 21 Jun 1948, *Peck 25313* (UC); 5 mi E of Harper, seepage slope, 21 Jun 1948, *Peck 25313* (UC). The two collections are labeled with the same collection number but apparently are from slightly different locations: the distance between Vale and Harper is about 21 miles.

Plants of *Letberg 533* from Linn Co., Oregon, are large and have the typical vegetative aspect of *Erythranthe arvensis*, but the pedicels, bracts, and calyces have a mix of eglandular-hirtellous and glandular hairs, atypical of the species. Plants from Stevens Co., Washington, are typical; those from British Columbia have a typical aspect and vestiture except for a slight admixture of hirtellous hairs.

Identification of Utah and southern Idaho populations as *Erythranthe arvensis* is a tentative hypothesis, as there appears to be little difference between them and the Colorado system of *E. hallii*, which is tightly coherent morphologically and geographically, but these plants need to be studied in the context of the larger group of annuals with autogamous flowers, as discussed under *E. charlestonensis*.

- 28. ERYTHRANTHE BRACHYSTYLIS** (Edwin) Nesom, Phytoneuron 2012-40: 43. 2012. *Mimulus brachystylis* Edwin, Leaflet. W. Bot. 7: 137. 1954. **TYPE:** USA. Nevada. Nye Co.: Moist loam around a spring on a steep north slope in Sunnyside Canyon about 5 mi N of Ione, 7000 ft, 14 Jul 1930, *K.H. Beach and L.E. Mills 881* (holotype: US digital image!, Fig. 9; isotype: UC!). The holotype includes about 10 plants, the isotype 7 plants.

**Annuals**, fibrous-rooted, less commonly taprooted, apparently sometimes producing thin runners from basal nodes. **Stems** erect, 6–22 cm, 4-angled, filiform to slightly thickened but not distinctly fistulose, glabrous. **Leaves** basal and cauline, blades ovate to depressed-ovate or suborbicular, margins undulate to subentire or weakly and irregularly dentate, apices rounded, bases truncate to subcordate, proximal petiolate, distal subsessile to sessile, proximal and medial glabrous, distal villous with thin-walled, flattened, vitreous hairs, with an admixture of eglandular, sharp-pointed hairs. **Flowers** 4–10, from medial to distal nodes. **Fruiting pedicels** 5–10 mm in proximal axils, shorter than or equalling subtending leaves, 1–5 mm distally and the calyces appearing sessile or subsessile, glabrous. **Fruiting calyces** broadly elliptic-ovoid, 10–13 mm, apparently not closing at the throat or only slightly so, red-tinged to sparsely purple-dotted or without dots, minutely hirtellous, lobes subequal, upper slightly longer than the others. **Corollas** yellow, apparently without red markings, tube-throats narrowly cylindric, 7–9 mm, exerted 0–1 mm beyond the calyx margin, limb weakly bilabiate or hardly at all, expanded ca. 3 mm (pressed). **Styles** glabrous. **Plesiogamous**; anther pairs and stigma at the same level. **Capsules** 4–5 mm, stipitate, included.

Known only from the type collection in Nye Co., Nevada. Map 15.

Figure 9. *Erythranthe brachystylis*. Holotype of *Mimulus brachystylis*, US.

*Erythranthe brachystylis* is very similar to *E. arvensis*. Both are annual in duration and produce depressed-ovate leaves, the distal with vitreous-villous surfaces, and tiny corollas barely exerted from the calyx and probably cleistogamous (the protologue of *Mimulus brachystylis* notes "style much shorter than the shorter pair of stamens, scarcely 3–3.5 mm long"). The vestiture of the distal leaves includes an admixture of eglandular sharp-pointed hairs, sometimes encountered in *E. arvensis*, though not typical, perhaps reflecting introgression from *E. nasuta*.

The distinction of *Erythranthe brachystylis* from *E. arvensis* is primarily in its foreshortened pedicels and more inflated fruiting calyces. The fruiting calyces appear to be subsessile or on pedicels shorter or only equalling the subtending leaves. The difference is qualitative but produces a distinctive aspect.

29. **ERYTHRANTHE CORDATA** (Greene) Nesom, Phytoneuron 2012-40: 43, 2012. *Mimulus cordatus* Greene, Leaf. Bot. Observ. Crit. 2: 5, 1909. **LECTOTYPE** (Pennell by annotation in 1941, formally designated here): USA. New Mexico. [Grant Co.]: Bear Mountain, near Silver City, about 5000 ft, 24 Apr 1903, O.B. Metcalfe 28 (US digital image! photo-PH!; isoelectotypes: DS digital image!, MO-2 sheets!, ND-Greene!, NY digital image!, PH!, UC!). Noted in the protologue: "part of [O.B. Metcalfe's] n. 28 as in U.S. Herb., the other specimens under that distribution number being of a very different species." The US sheet has a fruiting plant of *E. cordata* and four separate flowering branches of *E. geyeri*; Pennell in 1941 annotated the sheet to indicate that the single plant of *E. cordata* is the "TYPE." All plants on the DS, MO, ND-Greene, NY, PH, and UC sheets are *E. cordata*. Treated as a distinct species by Pennell (1951), who described the range as "southern California and northern Lower California, east to southern New Mexico."

*Mimulus maguirei* Pennell, Notul. Nat. Acad. Sci. Philadelphia 43: 6, 1940. **TYPE**: USA. Arizona. Coconino Co.: 2 mi W of Williams, Mt. Spring Ranch, among sedges under *Pinus ponderosa* in small swamp, 6500 ft, 26 Jun 1935, B. Maguire et al. 12214 (holotype: PH!). Annotated by F.W. Pennell in 1945 as *Mimulus longulus* Greene (a synonym of *Erythranthe arvensis*).

**Annual**, fibrous-rooted, sometimes producing leafy runners from basal nodes, stems often rooting at proximal nodes and appearing rhizome-like. Stems mostly erect, 12–40 cm, very rarely apparently greater than 100 cm, mostly simple, commonly fistulose, distinctly stipitate-glandular with fine, minute, gland-tipped hairs. Leaves basal and cauline, basal persistent, basal and lower cauline petiolate, petioles 6–20(–40) mm, blades orbicular to broadly elliptic-ovate or oblong-elliptic, basal largest, basal and midcauline 15–30(–50) mm, gradually reduced in size distally to as small as 6 mm, cauline mostly sessile, not connate, becoming broadly ovate to narrowly reniform, palmately 3–5(–7)-veined, margins shallowly and evenly to unevenly dentate, apex obtuse to rounded, base cuneate to truncate or shallowly cordate. Flowers (5–)10–16 in bracteate racemes. **Fruiting pedicels** 10–30(–45) mm, minutely stipitate-glandular. **Fruiting calyces** (8–)14–18(–20) mm, nodding 45°–90°, closing, apparently without red dots, upper lobe longest, 1.5–2 mm, sparsely stipitate-glandular to hirsutulous (or mixed glandular-hirsutulous), or glabrous. Corollas yellow, red-spotted, lower lip deeper yellow, tube-throats 8–14 mm, exerted 1–3 mm beyond calyx margin, limb weakly to strongly bilabiate, expanded 9–14 mm across (pressed). **Styles** glabrous. **Plesiogamous**; anther pairs and stigma at the same level. **Capsules** 5–7 mm, stipitate, included.  $2n = 60$ .

Flowering (Jan–)Mar–Jun. Springs, seeps, stream edges, muddy banks, flood plains, marshes and swamps, wash bottoms, wet depressions, wet places among boulders; (600–)800–2400(– ca. 3000) m. Arizona, California, Colorado, Nevada, New Mexico, Texas, Utah. Map 16.

A collection identified as *Erythranthe cordata* by the present author, voucher for  $n = 28$  (Catron Co., N.M., as cited below), needs to be rechecked for identity since six other chromosome counts for *E. cordata* have been  $2n = 60$  (San Bernardino Co., Calif.; Grant Co., N.Mex.; Brewster,

Culberson, Jeff Davis, and Presidio cos., Tex.). The chromosome number of *E. cordata* may indicate that it is not as closely related to *E. arvensis* ( $2n = 28$ ) as hypothesized here.

Collections examined. **MEXICO. Chihuahua.** 5 mi SW of Rancho Los Nogales along Piedras Verdes River, riparian, 5350 ft, 9 Jul 1997, *Spencer et al.* 393 (TEX). **Coahuila.** Mpio. Ocampo, Sierra del Carmen, Rcho. Morteros y Rcho. San Isidro, ca. 178 km de Musquiz por la brecha Muzquiz-Boquillas del Carmen (carr. 53), 1300 m, matorral rosetofofo, 27 Mar 1992, *Carranza et al.* 1327 (ARIZ); Mpio. Ocampo, Sierra Maderas del Carmen, moist zone along creek below Campo 5 in Oso Canyon, 29 May 1975, *Riskind & Patterson* 1836g (LL). **Sonora.** Palm Canyon, Sierra Bavisio, 17 mi SE of Magdalena on road to Cucurpe, seep on N-facing slope, 19 Mar 1978, *McCarten* 2725 (ARIZ); Dead Bull Canyon, near Arizpe, riparian, 17 Mar 1982, *Thompson & Davis* 82-31 (ARIZ); ca. 5 mi E of Esqueda along road to reservoir, in canyon, ca. 4000 ft, 6 Apr 19179, *Toolin* 259 (ARIZ); Rio de los Alisos (Rio Magdalena), 28.6 m S of Nogales along Mex Rte 15, in wet sandy mud, with *Populus fremontii* and *Platanus wrightii*, 14 Mar 1980, *Toolin* 543 (ARIZ); Palm Canyon, Sierra Bavisio, 17 mi SE of Magdalena, streamside, 13 Feb 1977, *Van Devender s.n.* (ARIZ); Rio Moctezuma, Moctezuma, Barisomari, 27 Jun 1938, *White* 341 (ARIZ); Rio Bavispe, Colonia Oaxaca, at water's edge, 7 Jul 1938, *White* 456 (ARIZ); Aguaje de Bacatejaca, between Granados and Bacadéhuachi, grassland, 7 Jul 1940, *White* 2917 (ARIZ).

Representative collections examined. **USA. Arizona. Cochise Co.:** Chiricahua Mts., E of Onion Saddle, 7200 ft, 31 Mar 1962, *Barr* 62-190 (ARIZ); Chiricahua Mts., Barfoot Park, 8000-8250 ft, 19 Sep 1906, *Blumer* 1399 (ARIZ); Mule Mts., Bisbee, wet places, Apr 1909, *Goodding* 53 (UT), *Goodding* 60 (ARIZ); Huachuca Game Preserve, Tinker Canyon, in edge of water, 14 Apr 1950, *Goodding* 123-50 (ARIZ); Dragon Mts., canyon below Van Horn Mine Cabin, 5 May 1953, *Goodding* 58-53 (ARIZ); Ft. Huachuca Military Reservation, Kino Spring, 22 Apr 1961, *Goodding* 17-61 (ARIZ-2 sheets). **Cocconino Co.:** lower part of Oak Creek Canyon, wet area, ca. 5000 ft, 8 May 1934, *Ferguson & Ottley* 5046 (UC). **Gila Co.:** 2 mi N of Greenback Creek at Bouquet Ranch, ca. 5 mi N of Theodore Roosevelt Lake, cattle tank/spring, bank's edge, 3 Apr 1991, *Baker* 8161 (ARIZ); Fort Apache Indian Reservation, Rock Creek crossing of Canyon Inn-Medicine trail, on and adjacent to seeps-wet soils, ca. 4000 ft, 26 Apr 1967, *Granfelt* 67-58 (ARIZ). **Graham Co.:** Turkey Creek, 6 mi W of Point of Pines, 70 mi E of San Carlos, flood plain of creek, ponderosa pine, 6200 ft, 24 Jul 1952, *Bohrer* 436 (ARIZ); Graham Mts., Tripp Canyon, 15 mi S of Pima, along water course, 9 Apr 1935, *Moeller* 10573 (ARIZ). **Maricopa Co.:** 4 mi S of Wickenburg, Palm Lake, marsh, 12 Apr 1966, *Crutchfield* 1526 (LL); Saucedo Mts., 1500 ft, 27 Mar 1960, *Johnson s.n.* (ARIZ); Lake Pleasant Regional Park, area #6, Cottonwood Creek, in creek, 27 Mar 1965, *Lehto* 4729 (ARIZ); Route 88, Apache Trail, Tortilla Flats, muddy bank of pool, 29 Mar 1940, *Pennell & Gibson* 24968 (ARIZ); Sierra Estrella above Santa Cruz Village, small plants on N-facing slope of wet cliff base, 570 m, 2 Apr 1985, *Rea* 608 (ARIZ). **Mohave Co.:** Black Mts., 3 mi E of Sitgreaves Pass, spring, 26 Mar 1967, *Barr* 67-97 (ARIZ); Cerbat Mts., 2 mi E of Chloride, 4500 ft, in mats in seep on cliff, 20 Apr 1979, *Bowers* 1659 (ARIZ); Outer Gorge, Toroweap, Saddle Horse Canyon, Devil's Bathub, under juniper, 4500 ft, 10 May 1952, *Cottam* 13251 (UT); along Trout Creek ca. 6 km downstream of Ash Creek [ca 34.88° N, 113.65° W], grus and granite substrate, with *Fraxinus velutina* and *Acacia greggii*, 3600 ft, 18 Apr 2006, *Rink* 4727 (ARIZ). **Pima Co.:** Organ Pipe Cactus Natl. Monument area, Dripping Spring, 15 Apr 1952, *Cottam* 12817 (ARIZ, UT); Puerto Blanco Mts., Dripping Springs, moist soil near spring, 2300 ft, 18 Mar 1945, *Darrow* 2443 (ARIZ); Ajo Mts., Alamo Canyon, 2500 ft, 14 Mar 1939, *Nichol s.n.* (ARIZ); northern Santa Rita Mts., moist wash bottom in desert grassland, 4450 ft, 5 Apr 1986, *McLaughlin* 3334 (ARIZ); along Arivaca Creek, 5.5 mi NW of Arivaca, walnut, ash, cottonwood, *Sambucus mexicana*, *Vitis arizonica*, 3450 ft, 3 Apr 1988, *McLaughlin* 4498 (ARIZ); Buenos Aires Natl. Wildlife Refuge, unnamed canyon on S side of Las Guijas Mts., moist face of Mesquite Root Dam, 3600 ft, 23 Mar 1989, *McLaughlin* 5476 (ARIZ); Saguaro Natl. Monument, canyon near Sweetwater Trail, wet depression in limestone bedrock, 3499

ft, 7 Mar 1989, *Rondeau 89-57* (ARIZ); Fort Lowell, Rillito River, 25 Apr 1903, *Thornber 5386* (ARIZ); Sabino Canyon, Santa Catalina Mts., 2 May 1903, *Thornber 5498* (TEX); Santa Catalina Mts., Sabino Canyon, common along water courses, 3000-5000 ft, 5 Apr 1913, *Thornber s.n.* (ARIZ); Tucson, 1 May 1894, *Toumey s.n.* (UC). Pinal Co.: Sacaton, Gila River bottom, 25 Mar 1932, *Harrison & Kearney 8383* (ARIZ). Santa Cruz Co.: Pajarito Mts., Sycamore Canyon, ca. 1/4 mi below Hank & Yank Spring, in water of stream in narrow canyon, oak woodland, ca. 4000 ft, 7 Apr 1974, *Longwell s.n.* (ARIZ); San Rafael State Park, Parker Canyon, wash in sandy soil with *Chilopsis linearis*, *Chrysothamnus nauseosus*, 28 Mar 2001, *McLaughlin 9096* (ARIZ); Santa Rita Mts., 6 Apr 1935, *Nelson 1398* (UC); mountains between Ruby and the Tucson-Nogales hwy., "Massacre Camp," rocky stream banks, 12 Apr 1935, *Nelson & Nelson 1478* (MO); Sonoita River, near Patagonia, 4000 ft, 22 Mar 1925, *Shreve s.n.* (ARIZ); mts. near Patagonia, Apr 1908, *Thornber 2905* (ARIZ-2 sheets). Yavapai Co.: Prescott Natl. Forest, Milk Creek, 7 mi N of Wagoner, riparian, 3900 ft, 28 Apr 1968, *Carpenter s.n.* (SMU); Bradshaw Mts., 22 Jun 1892, *Toumey s.n.* (UC). California. San Bernardino Co.: Deet(?) Canyon between Whipple Mts., and Black Meadows Wash, Power Line Rd, Parker Dam, marshy ground, bottom of canyon, 21 Apr 1940, *Alexander & Kellogg 1186* (UC 667449); Whipple Mts., sandy wash, in seep, 25 Apr 1940, *Alexander & Kellogg 1220* (UC); Whipple Mts., marshy meadow in a deep canyon, Vickery cult. 5063, seeds from UC 667449, "1 to 3 ft in nature but only 6 inches to 1 ft in greenhouse," voucher for  $n = 30$  (UC, UT-3 sheets); Mohave Desert, W slope of Providence Mts., 6 airline mi E of Kelso in Cornfield Spring Canyon, *Larrea-Yucca schidigera*, wet gravel along stream banks, 3400 ft, 28 May 1941, *Wolf 10818* (UC). Nevada. Clark Co.: Pintwater Range, Tim Spring, 4800 ft, 22 Jul 1978, *Ackerman 31231* (UC); Opal Mts., Delaney Canyon, 2 mi S of Nelson, 4200 ft, 27 Apr 1938, *Train 1512* (UC). Nye Co.: W Frenchman, enclosure above Cane Springs pond, 4000 ft, 2 Jun 1967, *Beatley 3999* (JEPS); NW Yucca Flat, Whiterock Spring, seepage area, 5000 ft, 16 Jun 1967, *Beatley & Bostick 4109* (JEPS). New Mexico. Catron Co.: Blue River, Apache Natl. Forest, growing on gravel at edge of water, 25 Aug 1966, *Crutchfield 2084* (LL); 10 mi S of Reserve, S of jct of NM Hwy 12 with US 80, shallow rocky stream, open sunny area, 5800 ft, 28 Jun 1963, *Vickery & Tai 7*, cult. no. 6613, voucher for  $n = 28$  (UT); Gila Cliff Dwellings Natl. Monument, 15 May 2001, *West 448* (ARIZ). Dona Ana Co.: Organ Mts., May 1891, *Wooton s.n.* (NMC); Organ Mts., Filmore Canyon, 15 May 1899, *Wooton s.n.* (NMC); Organ Mts., Filmore Cañon, 26 May 1905, *Wooton s.n.* (NMC); Organ Mts., 28 May 1905, *Wooton s.n.* (UC). Grant Co.: Foxtail Canyon on Gila River, wet granitic sand, 27 Apr 1966, *Crutchfield 1381* (LL); Burro Mts., W.C. Silby's Range, Gila Forest, 1880-2180 m, 22 Oct 1919, *Eggleston 16440* (PH); 4.5 mi N of 516 Ranch, Mogollon Creek, with *Quercus*, *Juniperus*, *Juglans*, *Rhus*, *Platanus*, 11 Jun 1935, *Maguire et al. 11936* (MO); 2.5 mi N of Pinos Altos, wet shaded hillside about spring in canyon, 24 Apr 1947, *McVaugh 8043* (TEX); mountains near Pinos Altos, 26 Jun 1936, *Stewart s.n.* (MO); Mangus Springs, 17 road mi NW of Silver City, growing in Mangus Spring at its intersection with the sandy arroyo of Mangus Creek, which passes under US-180, 4800 ft, 12 May 1981, *Ward & Salazar 82-013*, voucher for  $n = 30$  (NMC). Hidalgo Co.: Guadalupe Canyon, 15 mi E of jct with road to Douglas, Arizona, *Juniper-Agave-Yucca* zone, sandy soil along edge of creek, 4200 ft, 20 Apr 1968, *Hess 1776* (NMC); Peloncillo Mts., Hwy 80 at Granite Gap, sandy wash, 4500 ft, 30 Apr 1983, *Worthington 10,133* (UT). Luna Co.: wet places in old creek bed, canyon E of road, foothills E of Cook's Peak, 12 mi NW of Florida Station, 29 Apr 1947, *McVaugh 8130* (TEX-2 sheets); Florida Mts., NW side of mts., SE of Capitol Dome, 5300 ft, 30 Apr 1983, *Worthington 10133* (UT). San Juan Co.: 10 mi W of Farmington, seep area, 27 Jun 1963, *Tai & Vickery 1* (UT). Sierra Co.: 1 mi W of Hillsboro, 5600 ft, 1 May 1905, *Metcalfe 1537* (MO-2 sheets, NMC, TEX-2 sheets). Socorro Co.: Water Canyon, Cibola Natl. Forest, in S Baldy area, small spring in canyon, pine-oak-juniper, 3 Jun 1965, *Crutchfield 112* (LL, NMC); mountains SE of Patterson, 5800 ft, 16 Aug 1900, *Wooton s.n.* (NMC). Texas. Brewster Co.: Alpine Creek below Kokernut Springs, 18 May 1946, *Cory 53186*, Vickery cult. 5373, voucher for  $n = 30$  (UT); Big Bend Natl. Park, Tornillo Creek near Hot Springs, 20 Apr 1948, *Whitehouse 19715* (SRSC). Culberson Co.: W side of Beach Mt., ca. 7 mi NW of Van Horn, edge of seep, 7 Sep 1963, no collector cited, *Vickery cult. 6296*, voucher for  $n = 30$  (UT). El Paso Co.:



ca. 20 mi E of El Paso, frequent in wet places among boulders at Hueco Tanks, 4000 ft, 5 Apr 1958, *Warnock & Johnston 16158* (MO, SRSC, TEX); Hueco Mts., Hueco Tanks, dried bottom and edges of pond, silty soil, 20 Aug 1946, *Waterfall 6606* (MO); Franklin Mts., Ash Canyon, 0.5 mi SE top N Franklin Mt., in mesic canyon among rhyolite boulders at springs and seeps, 29 Apr 1978, *Worthington 2711* (TEX). Jeff Davis Co.: near Ft. Davis, Limpia Creek, in shallow pools, 10 Oct 1926, *Palmer 32152* (TEX); Davis Mts., wet ground about spring, 8 Jun 1928, *Palmer 34402* (MO); Limpia Canyon, 5000 ft, 30 Jun 1962, *Tai & Vickery 12*, cult. 6618, voucher for  $n = 30$  (UT); Davis Mts., frequent along Limpia Canyon, Wild Rose Pass, 4700 ft, 24 May 1949, *Warnock 8652* (SRSC). Presidio Co.: Tapia Canyon, 12.4 mi E of Redford, in wet sand and seepage, 16 Apr 1965, *Correll 30859* (LL); Pinto Canyon near Ruidosa, abundant in spring water, 13 Apr 1919, *Hanson 590* (MO); Fresno Creek, 5 mi upstream from road to Lajitas, 12 Jul 1982, *Johnston & Warnock 3682*, Vickery cult 6294, voucher for  $n = 30$  (UT); W side of Chinati Mts., infrequent in moist areas below dam in lower Tinaja Prieta Canyon, 3900 ft, 10 Nov 1988, *Warnock 275* (SRSC). Utah. Kane Co.: Cottonwood Wash Canyon, 26.5 mi SE of the jet of the Cottonwood Wash road and Utah Hwy 54 at Cannonville, at Cottonwood Wash Spring, 5100 ft, 7 Jun 1967, *Reveal 819* (TEX). Washington Co.: Zion Natl. Park, Horse Pasture Plateau, where Potato Hollow ends at cliffs edge, wet marsh below small reservoir, 6750 ft, 22 Jun 1965, *Holmgren 1995* (TEX); Zion Natl. Park, Emerald Pool Trail, 4000 ft, 6 May 1935, *Weight 838c* (UT).

*Erythranthe cordata* is characterized by its fibrous-rooted habit (annual in duration, without rhizomes but commonly rooting at the lower nodes), short corollas and autogamous fertility (anthers and stigma at the same level), closed calyces, sparsely villous-glandular vestiture (lacking hirtellous, eglandular hairs), and stems commonly fistulose in larger plants. The abbreviated corollas with autogamous fertility of *E. cordata* are diagnostic and separate it from *E. guttata*. The difference in chromosome number also points to their evolutionary distinction.

The following contrasts, using style length even when corollas are absent, usually provide a distinction between the two species.

- |  |                                   |
|--|-----------------------------------|
| 1. Corolla tubes 8–14 mm, exserted 1–3 mm beyond calyx margin, limb expanded 9–14 mm (pressed); styles 7–10 mm, exserted 1–3 beyond fruiting calyx margin; plerogamous .....                   | <b><i>Erythranthe cordata</i></b> |
| 1. Corolla tubes (10–)12–20(–26) mm, exserted 3–5 beyond calyx margin, limb expanded 12–24(–25) mm (pressed); styles 15–20 mm, exserted 6–9 mm beyond fruiting calyx margin; herkogamous ..... | <b><i>Erythranthe guttata</i></b> |

In the interpretation here, plants of *Erythranthe cordata* are highly variable in size — from tiny fibrous-rooted plants with nearly filiform stems to much larger individuals with fistulose stems rooting at proximal nodes. Label comments for a Kane Co., Utah, population of *E. cordata* (*Reveal 819*) are congruent with the observations of the present study over the whole range of the species: "This population is exceedingly variable as the plants range from less than 1 cm high to over 8 dm high; growing both in seeps where the plants are large to sandy flats along the stream where the plants are 1–4 dm high, to grassy flats where the same plants were as small as 1 cm."

*Erythranthe cordata* and *E. nasuta* are sympatric in Arizona and southeastern New Mexico and small plants of each species may be very similar in aspect, both with cleistogamous corollas and both with reduced vestiture. Those of *E. nasuta* can be recognized by the distal and bracteal leaves with hirtellous to hirsutulous adaxial surfaces — a lens usually is required to see this feature and it sometimes is most obvious around the leaf margins. A possible hybrid between the two, with the aspect of *E. cordata* but leaves, pedicels, and calyces with a mixture of stipitate-glandular and

eglandular-hirtellous hairs, is this: Arizona. Yavapai Co.: Black Canyon, 2000 ft, 14 Apr 1960, Demaree 42259 (ARIZ).

30. **ERYTHRANTHE CHARLESTONENSIS** Nesom, sp. nov. TYPE: USA. Nevada. Clark Co.: Charleston Mts., Griffith's Mine, moist sloping rock, 2400 m, 25 Jun 1938, *I.W. Clokey 8116* (holotype: UC!; isotypes: MO-2 sheets!, TEX-2 sheets!).

**Annual**, fibrous-rooted; stems, leaves, calyces commonly dark purplish. Stems erect, 4–16(–24) cm, simple, slender, weakly 4-angled, glabrous. Leaves basal and cauline or basal deciduous, largest at midstem or above, cauline relatively few on long internodes, blades regularly ovate to ovate-lanceolate, 5–16(–20) x 3–11 mm, palmately 3-veined, proximal glabrous to sparsely villous on both surfaces, distal and bracteal sparsely villous adaxially with vitreous, flattened, eglandular hairs, sparsely hirtellous to glabrous abaxially, margins shallowly and evenly crenulate to serrate-dentate or denticulate, apices acute to obtuse, bases truncate to subcordate, proximal to distal all short-petiolate (1–3 mm). Flowers (1)–4–7, often from all nodes but commonly beginning about midstem. **Fruiting pedicels** 6–19 mm, deflexed 45°–90° at the calyx glabrous or villous-glandular near the nodes. **Fruiting calyces** 10–13 mm, closing, sometimes purple-dotted, minutely hirtellous, sometimes also sparsely glandular, margin villous at the sinuses, upper lobe not prominently protruding or only slightly so. **Corollas** yellow, sparsely red-dotted, tube-throats narrowly cylindric, 4–6 mm, exerted 0.5–1 mm beyond calyx margin, limb barely expanded, nearly regular. **Styles** glabrous. **Plesiogamous**; anther pairs and stigma at the same level. **Capsules** 6–8 mm, stipitate, included.

Flowering Apr–Jul(–Aug). Grassy slopes, damp soil, moist rocks; (900–)1700–2400(–2800) m. Arizona, Nevada. Map 15.

Additional collections examined. **Arizona.** Mohave Co.: 20 mi from Kingman, Union Pass, [ca. 2600 ft], 30 May 1893, *Wilson 25* (UC). **Nevada.** Clark Co.: Charleston Mts., McFarland Springs, grassy slope, 2425 m, 4 Jul 1938, *Clokey 8115* (SMU, UC); Charleston Mts., Fletcher Canyon, damp soil with *Pinus scopulorum*, 2250 m, 20 Jul 1939, *Clokey 8493* (UC); Charleston Mts., Griffith's Mine, moist sloping rock, 2400 m, 12 Jul 1939, *Clokey 8494* (UC); Charleston Mts., Vic Wilson's Ranch, Right Hand Canyon, 3 May 1939, *Maguire 16603* (UC); Timber Mt., Highland Spring, 15 mi NW of Bell Ranch, 5000 ft, 25 Apr 1938, *Tram 1487* (UC). **Elko Co.:** Ruby Mts., Terrace Guard Station, 8500 ft, 13–18 Aug 1941, *Mills & Beach 1460* (UC).

The epithet of the new species refers to the Charleston Mountains (a.k.a. Spring Mountains) of Clark County, where the plants have been most abundantly collected. This population system is recognized here at specific rank because it is relatively constant in morphology and it cannot be definitely associated with any of the other annuals with autogamous flowers that occur in the region – *Erythranthe arvensis*, *E. brachystylis*, *E. cordata*, *E. nasuta*, and *E. hallii*. The species is characterized by its annual duration, autogamous flowers, small stature and commonly purplish color of stems and leaves, regularly ovate, short-petiolate leaves with shallowly crenate margins and (distal leaves) sparsely villous to glabrous adaxial surfaces, hirtellous calyces without a prominently longer upper lobe, and lack of glandular hairs.

Individuals of all of these six species may flower when as small as 2–5 centimeters high, and the distinctions among them at such small sizes commonly are subtle. There is no feature of *E. charlestonensis* without overlap in the other species, but the same is essentially true of all of the species. Each has its own distinctive and relatively consistent constellation of characters and distinctive geographical range. Overlap in morphology may reflect hybridization and introgression, or it might be reflective of the ancestral genome from which they all probably arose — or both.

*Erythranthe hallii* has a relatively more northern distribution (Map 15) and its leaves and calyces and very thin and greenish; plants often are completely glabrous or the distal leaves and bracts are slightly villous adaxially. The chromosome number has been reported as  $2n = 32$ , distinct from the  $2n = 28$  of *E. nasuta* and  $2n = 30$  of *E. cordata*.

*Erythranthe arvensis* has a more western and northern distribution (Map 15) and rarely develops purple coloration. The plants, including the calyces, usually are glabrous except for the distal leaves and bracts, which are prominently and diagnostically silvery-villous adaxially. At least the middle and upper cauline leaves typically are depressed-ovate to nearly reniform in outline, and the calyces of *E. arvensis* tend to remain open at maturity. The narrow endemic *E. brachystylis* (Map 15) is most similar to *E. arvensis*.

*Erythranthe nasuta* (Map 21) occurs sympatrically with *E. charlestonensis*. Even in smallest sizes, it is characterized by a noticeably longer upper calyx lobe and by distal leaves and bracts that are moderately to densely hirsutulous-hirtellous on both surfaces at least around the proximal margins. Leaf margins are variable but often, as in the larger plants, unevenly and shallowly dentate with sharp teeth.

*Erythranthe cordata* (Map 16) in a characteristically larger growth expression occurs sympatrically with *E. charlestonensis*. Pedicels and calyces of *E. cordata* are sparsely to moderately villous-glandular. The presence of hirtellous vestiture distinguishes it from small individuals of *E. cordata*.

**31. ERYTHRANTHE HALLII** (Greene) Nesom, Phytoneuron 2012-40: 43. 2010. *Mimulus hallii* Greene, Bull. Calif. Acad. Sci. 1: 113. 1885. *Mimulus guttatus* var. *hallii* (Greene) A.L. Grant. Ann. Missouri Bot. Gard. 11: 172. 1924. **LECTOTYPE** (Grant 1924, p. 173): USA. Colorado. [Jefferson Co.:] about Golden City, in shady ravines, at lower altitudes only, 1871, *E. Hall* and J.P. Harbour 398 (MO!). Protologue: "Collected by Hall & Harbour apparently, and also later by the writer, in 1871. ... It is remarkable for having, for the size of the plant, the smallest corollas of any of the species." Identified by Weber and Wittmann (1992) as "a very depauperate modification" of *Mimulus guttatus*.

**Annual**, fibrous-rooted. **Stems** erect, 2–8 cm, simple, slender, 4-angled, sometimes apparently rooting at lower nodes if proximally decumbent, glabrous. **Leaves** basal and cauline or basal deciduous, largest at midstem or above, cauline relatively few on long internodes, blades ovate to ovate-lanceolate, 5–11 × 3–9 mm, palmately 3-veined, glabrous or the distal and bracteal leaves sparsely villous with vitreous, flattened, eglandular, multicellular hairs, margins very shallowly dentate or denticulate, apices acute to obtuse, bases truncate to cuneate, basal and lower to mid cauline with petioles 1–4 mm, sessile distally. **Flowers** (1)–4-ca. 10, sometimes from all nodes but usually beginning about midstem. **Fruiting pedicels** 6–14 mm, usually deflexed ca. 90° at the calyx. **Fruiting calyces** (5–)7–10 mm, closing, sometimes red-dotted, glabrous, margin villous at the sinuses, upper lobe not prominently protruding or only slightly so. **Corollas** yellow, often red-dotted, tube-throats narrowly cylindric, 4–6 mm, exserted 0.5–1 mm beyond calyx margin, limb barely expanded, nearly regular. **Styles** glabrous. **Plesiogamous**; anther pairs and stigma at the same level. **Capsules** 4–6 mm, stipitate, included  $2n = 32$  (voucher from Grand Co., Douglas 61-480, UT).

Flowering May–Aug. Ledges, seeps, along streams, wet meadows; 1900–3200 m; Colorado (Boulder, Clear Creek, Grand, Jefferson, Larimer counties). Map 15.

Additional collections examined. **Colorado. Boulder Co.:** Boulder, stream, 5700 ft, 20 Jun 1906, Daniels 25 (MO); along trail from Buckingham campground to Fourth of July Mine, wet meadows, 9500 ft, 13 Aug 1979, Teare and Taylor 1339 (DAV); seepage over granite slabs at base of

S-facing slope in *Pinus ponderosa* woodland along Boulder Creek, 5600 ft, 21 Jun 1979, *Taylor and Teare* 7396A (DAV); beside a spring near summit of Flagstaff Mt., just W of Boulder, 7000 ft, 18 May 1949, *Weber* 4653 (TEX, UC); 8 mi W of Lyons, South St. Vrain Canyon, 6300 ft, 12 Jun 1922, *Wiegand & Upton* 4257 (MO). Clear Creek Co.: Georgetown, damp places, 18 Jul 1892, *Patterson* 294 (MO, UC). Grand Co.: Devil's Staircase, East Inlet, 3.5 mi E of Grand Lake, Shadow Mt. area, moss banks on cliff in temporary seep areas, ca. 9000 ft, 20 Jul 1961, *Douglas* 61-315 (UT); North Inlet 1/4 mi below Cascade Fall, 3 mi NE of Grand Lake, shaded ledge, under overhanging, S-facing cliffs, 8800 ft, 7 Aug 1961, *Douglas* 61-480, voucher for  $n = 16$  (UT); Little Yellowstone Canyon, 14.5 mi N of Grand Lake, Rocky Mt. Natl. Park, gravel at streamside, 9560 ft, 10 Aug 1961, *Douglas* 61-488 (UT). Jefferson Co.: Morrison, moist soil, 1970 m, 3 Jun 1921, *Clokey* 4287 (UC); Morrison, 27 Jul 1889, *Greene* s.n. (ND-Greene). Larimer Co.: Estes Park, moist ground, 29 Jun 1912, *Churchill* s.n. (MO); Loveland, 55 mi above dam in Big Thompson Canyon, in seep on rocky ledge, no date, *Vickery* cult 7313 (UT).

*Erythranthe hallii* may be an eastern vicariant of *E. arvensis*. — both have a tendency to root at basal nodes and distal and both have bracteal leaves villous with vitreous, flattened, eglandular, multicellular hairs although this vestiture is barely developed and often absent in *E. hallii*. The only reported chromosome number from the Colorado plants,  $2n = 32$ , also appears to be distinct among possible relatives of *E. hallii*, and if the count is correct, the species perhaps is not so closely related to others of the Microphylla group.

*Erythranthe hallii* is endemic to the same area of Colorado and has the same chromosome number as *E. gemmipara*. The latter, however, is different in calyx morphology and molecular data (Beardsley et al. 2004) indicate that it is distantly related to sect. *Simiolous*. *Erythranthe gemmipara* is treated by Barker et al. (2012) as a monotypic section of the genus.

32. **ERYTHRANTHE DENTILOBA** (B. Rob. & Fernald) Nesom, *Phytoneuron* 2012-40: 44. 2012. *Mimulus dentilobus* B. Rob. & Fernald, *Proc. Amer. Acad. Arts* 30: 120. 1894. **TYPE:** MEXICO. Sonora. Nacori, 3750 ft, 4 Dec 1890, *C.V. Hartman* 288 (holotype: GH photo-PH!; isotypes: NY digital image!, US digital image!). Fig. 8.

Perennial, rhizomatous, mat-forming. Stems prostrate, 5–15 cm, rooting at the nodes, glabrous to very sparsely glandular. Leaves cauline, petiolate, blades ovate to broadly ovate or orbicular, depressed-ovate, 2–10(–17) x 2–10(–20) mm, palmately 3-veined, surfaces glabrous or rarely sparsely villous-glandular adaxially with vitreous flattened hairs, commonly punctate adaxially, margins dentate to dentate-serrate with 3–5 teeth per side, apices mostly obtuse, bases truncate to cuneate, petioles 1–4 mm. Flowers axillary, usually 1 per stem at distal nodes. Fruiting pedicels 5–25 mm, glabrous. Fruiting calyces cylindric-ovoid, 5–7 mm, lobes 5 or 3(+2), closing, nodding 45°–90°. Corollas yellow, red-dotted, tube-throats funnelliform, 5–7 mm, exerted 2–3 mm beyond calyx margin, limb bilabiate, expanded 6–9 mm (pressed), lobes fimbriate. Herkogamous; anther pairs at different levels, stigma above upper anther pair.  $2n = 32$ .

Flowering Mar–Sep(–Oct). Springs, seeps, canyon bottoms, cliff faces, rocks in water, moist banks; 500–2300 m; Mexico (Baja California, Chihuahua, Sinaloa, Sonora). Map 22.

Additional collections examined. MEXICO. Baja California Sur. N side of Cerro de la Giganta, western branch of Arroyo Hondo, near spring, ca. 700–800 m, 28 Nov 1947, *Carter et al.* 2077 (ARIZ); Sierra Giganta, above Pto. Escondido, moist rocks in canyon bottom, 2000 ft, 22 Apr 1938, *Gentry* 3772 (ARIZ, MO); Sierra de las Palmas, La Champagna, S of Santa Rosalia, in seeps, *Nolma* grassland over undulating broken terrain of volcanic mountain top, 27–29 Apr 1952, *Gentry & Fox* 11792 (ARIZ); canyon above Puerto Escondido, 13 Mar 1937, *Rempel* 161 (ARIZ). Chihuahua. S slope, Barranca del Cobre, in arroyo, short tree forest, 4200 ft, 11 Apr 1963, *Caddell* 1062 (BRIT);



Figure 10. *Erythranthe dentiloba*, photo by Mark Egger, used by permission. Sonora, Mexico, along Mex. Hwy 16 between Trigo Colon and Maycoba, 17 Aug 1998.

Sierra Charuco, Arroyo Hondo, pine forest spring, on moist rocks, 11 Sep 1935, *Gentry 1765* (ARIZ); Guicorichi, Rio Mayo, meadow spring, on rocks at water edge, 8 Oct 1935, *Gentry 1990* (ARIZ, UC); Sierra Charuco, Rancho Byerly, rocky igneous slopes, pine-oak forest, 5000–5800 ft, 17–25 Apr 1948, *Gentry 8085* (ARIZ, UC); Sierra Charuco, Arroyo Hondo, igneous rocky canyon slope in pine-oak forest, aquatic, 4500–5500 ft, 16–30 Apr 1948, *Gentry 8073* (ARIZ, UC); Mpio. Temosachi, Nabogame, pine-oak-cypress forest, 1800 m, 12 Oct 1988, *Laferriere 1946* (ARIZ); Mpio. Temosachi, Nabogame, arroyo, 1800 m, 24 Apr 1987, *Laferriere 372* (ARIZ); Parque Nacional de Cascada Basaseachic, in the barranca at the base of the falls, wet, bare, slick rock at the base of the trail on steep N slope, shaded with *Abies*, *Ostrya*, *Acer*, 1600 m, forming dense mats on the rocks where moist, 11 Nov 1989, *Mahrt & Spellenberg 79* (NMC); Sierra Obscura, spring seep, 1600 m, 26 Mar 1985, *Martin s.n.* (ARIZ); Sierra Obscura between Rancho El Oso and Sawmill at El Serrichito, basaltic soils, 2000 m, 7–9 Nov 1986, *Martin et al. s.n.* (ARIZ); Canon de Lopez, 1350 m, 17 Mar 1988, *Martin s.n.* (ARIZ); Mpio. Ocampo, Parque Nacional de Cascada Basaseachic, barranca to W of falls, at base of dry cliffs in more or less open, dry *Pinus durangensis-Quercus hypoleucoides* woods, ca. 1800 m, 26 Apr 1985, *Spellenberg et al. 8030* (NMC); near Chuichupa in the Sierra Madres, 31 Aug 1899, *Townsend & Barber 388* (NMC); Cascada de Basaseachic, Rio Basaseachic, pine-oak forest, common herb in moist soil at edge of stream, 4 Jun 1999, *Van Devender 99-215* (NMC); Cascada de Basaseachic, Rio Basaseachic, pine-oak forest, abundant herb on wet rock surface under waterfall, 1800 m, 4 Jun 1999, *Van Devender 99-220* (NMC). **Sinaloa.** 5 mi N of El Palmito, slopes and ledges of barranca with *Pinus* and *Quercus*, 2300 m, 28 Oct 1973, *Breedlove 35728* (MO); Sierra Surotato, Los Pucheros, Penasco, pine-oak-madrone forest, in seep of cavern on calcareous cliff, 5500–6500 ft, 17–24 Mar 1945, *Gentry 7220* (ARIZ). **Sonora.** Rio Mayo region, KM 196 on Hwy 16, Tiithonia stop W of Tepoca, 950 m, 14 Mar 1988, *Ferguson s.n.* (ARIZ); Agua Salado, 15 mi NE of Los Tanques by road, below seep in small side canyon along road from Los Tanques to Las Chinacas, tropical deciduous forest, 500 m, 15 Mar 1992, *Fishbein et al. 87* (ARIZ);

along Hwy 16, 3.6 mi E of Rio Maycoba crossing, N-facing cliff with seeps in oak woods, 1400 m, mat-forming herb, 7 Sep 1995, *Fishbein et al.* 2516 (ARIZ); Rio Mayo, San Bernardino, arroyo, water in rocks, Toiwe, 25 Feb 1935, *Gentry* 1353 (ARIZ, UC); Los Tepalcates on old road to Bermudez, 1450 m, 15 Mar 1988, *Martin s.n.* (ARIZ); Los Cien Pinos, 1700 m, 16 Mar 1988, *Martin s.n.* (ARIZ); Sahuarivo to Coroqui, upper short tree forest, 900 m, 18 Mar 1992, *Martin et al. s.n.* (ARIZ); 18.3 mi E of the Rio Yaqui bridge near Tonichi, on the road to Carrizal and Santa Rosa, canyon with many palms, 3200 ft, locally common perennial herb along a stream, mat-forming, 27 Mar 1983, *Sanders* 3717 (UC); Mpio. de Alamos, Arroyo El Cobre, ca. 9 km (by air) N of Guirocoba below (just W of) Choquincahui (El Cobre), among mosses and liverworts in the moistened soil of a seep along the arroyo bank, riparian tropical deciduous forest, 520 m, 17 Mar 1995, *Steinmann et al.* 621 (ARIZ).

All plants of sect. *Simiola* with lacinate-lobed corollas (Mexico, Arizona, New Mexico, and Texas) have generally been identified as *Mimulus dentilobus*, but these occur as three, morphologically distinct, widely allopatric population systems, each of which is treated here as a separate species. There is no evidence of intermediacy. *Erythranthe dentiloba* is the only one of the three with an allogamous breeding system.

33. *ERYTHRANTHE PARVULA* (Woot. & Standl.) Nesom, *Phytoneuron* 2012-40: 44. 2012. *Mimulus parvulus* Woot. & Standl., *Contr. U.S. Natl. Herb.* 16: 171. 1913. TYPE: USA, New Mexico, Grant Co.: "vicinity of Silver City, Fort Bayard, Santa Rita, Fierro, the Mimbres Valley and East Canyon tributary to it, and on the G.O.S. Ranch, in canyons withing 10 miles of the ranch house," Rocky Canyon, 29 Aug 1911, *J.M. Holzinger s.n.* (holotype: US digital image!; isotype: MO!). The US sheet has the date "9 August" handwritten on the label, but the MO sheet has "Aug 29." Because the printed label gives the range of collection dates as "Aug. 27 to Sept. 12, 1911" presumably the handwritten date on the US label was in error and the correct date is August 29.

Perennial, rhizomatous, mat-forming. Stems prostrate, 5–15 cm, sometimes rooting at the nodes, stipitate-glandular distally. Leaves cauline, petiolate, blades ovate to orbicular-ovate or depressed-ovate, 3–11 mm x 3–9 mm, palmately 3-veined, villous-hirsute on both surfaces, densely so adaxially, margins shallowly denticulate to dentate with 3–5 teeth per side, apices acute to obtuse, bases truncate to cuneate, petioles 1–4 mm. Flowers axillary, few and scattered at distal nodes. Fruiting pedicels 7–15 mm, minutely stipitate-glandular. Fruiting calyces cylindric-ovoid, 4–5 mm, closing, nodding 45°–90°, 5-lobed, moderately to densely villous-glandular. Corollas yellow, red-dotted, tube-throats funnellform, 6–8 mm, exserted 4–5 mm beyond calyx margin, limb bilabiate, expanded 4–6 mm (pressed), lobes fimbriate. Plesiogamous; anther pairs barely separated in level and essentially contiguous, stigma even with upper anther pair.  $2n = 32$  (Arizona, Maricopa Co.: along Eagle Creek, *Vickrey* 13007, UT). Fig. 9.

Flowering Apr–Sep. Wet vertical rock faces, ledges, and rocky slopes, seepy wash banks; 500–2400 (–3400) m. Arizona, New Mexico; Mexico (Sonora). Map 23.

Additional collections examined (ASU fide SEINet). MEXICO. Sonora. 4 mi E of Rancho Diablo in Cajón Bonito, on the SW-facing bare rock, 1 May 1976, *Mason* 3199 (ARIZ). USA. Arizona. Graham Co.: Upper Gila River drainage, on Bonita Creek, near mouth of Midnight Canyon, in mats on rocky W-facing canyon wall, a few inches to 1 ft above water, ca. 3800 ft, 21 Jun 1978, *McGill* 2391 (ARIZ, ARIZ digital image!); Aravaipa Canyon, east end, near confluence with Turkey Creek, S-facing seepage cliffs above creek, vertical cliffs and ledges (rhyolite?), riparian vegetation, 3000 ft, 2 Apr 1977, *Reeves* 5456 (ARIZ). Greenlee Co.: 5 or 6 mi SE of Morenci, Eagle Creek Hot Springs, canyon, 5000 ft, 29 Jan 1977, *Bissonette* 7460 (ARIZ); Eagle Creek above confluence with Gila river, upstream from pump station, vertical conglomerate canyon walls, 6 Sep 1998, *McGill* 7003 (ARIZ); Eagle Creek, narrow riparian canyon and hillside, 3700 ft, 29 Jun 1977, *Minckley s.n.*

(ARIZ). Maricopa Co.: Lower Camp Creek, seep spring in face of cliff, N slope, silt on rock cliff, 1600 ft, 14 Sep 1952, *Blakley B-1597* (ARIZ); Superstition Mountains, Le Barge Canyon, along stream 2340 ft, 7 Apr 1963, *Lehto 1719* (ARIZ) and *1719-b* (ARIZ); Camp Creek, 2.1 road mi W of confluence with Verde River, wash bank with seeps, 7 Jun 1977, *McGill 1415* (ARIZ, ASU). Pinal Co.: Peralta Canyon in Superstition Mountains foothills 1900 ft, 21 Mar 1965, *Lehto 4631* (ARIZ). Yavapai Co.: Tangle Creek; ca 2 km SE of Tangle Peak and ca. 5 km NW of the Verde River, SE-facing seep, prostrate annual in wet soil at base of small, shallow caves, 762 meters, 12 April 1992, *Baker 8815* (ARIZ). **New Mexico**. Catron Co.: Little Creek, 4 mi S of Gila Cliff Dwellings, Gila Natl. Forest, attached to rock cliff in dripping wet area, 6 Jun 1965, *Crutchfield 139* (LL); Mogollon Mountains at Whitewater Spring, 10,200 ft, 9 Sep 1980, *Fletcher 4879* (UNM, fide SEINet); upper end of Snow Lake in the Gila National Forest, gravel and silty loam of mud flats, 7300 ft, 12 Sep 1990, *Hutchins 12740* (UNM, fide SEINet). Grant Co.: Bear Canyon, 6 mi E of Gila, forming dense mats on moist vertical sides of overhanging cliffs, 5000 ft, 23 May 1935, *Maguire et al. 11662* (UC).



Figure 11. *Erythranthe parvula*, habit, flower, and leaf. Photos by Russ Kleinman, Bill Norris, and Kelly Kindscher, Western New Mexico Univ. Dept. of Natural Sciences and the Dale A. Zimmerman Herbarium. Vascular plants of the Gila Wilderness. **New Mexico**, Grant Co., Black Range, Rocky Canyon, 4 Jun 2009.

34. **ERYTHRANTHE CHINATIENSIS** Nesom, sp. nov. TYPE: USA. Texas. Presidio Co.: Chinati Mtns. State Natural Area, Pelillos Canyon, deep pool at foot of dam, Boulder Canyon, a large steep, bowl-shaped igneous area N side of Chinati draining off Chinati Peak, riparian area and seeps from crevices in igneous rock face of canyon wall, 3775 ft, associates include *Salix gooddingii*, *Cephalanthus*, *Juglans microcarpa*, *Tecoma stans*, *Brickellia*, *Perityle dissecta*, *Mimulus dentilobus*, and small frogs, mat-forming, flrs yellow, upper lobes paler than middle lower lobe, reddish maroon spots in throat, 17 Sep 2004, Lott et al. 5316 (holotype: TEX). Fig. 10.

Different from *Erythranthe dentiloba* in its autogamous flowers and strongly reflexed lower corolla lip. Different from *Erythranthe parvula* in its nearly glabrous leaves and its strongly reflexed lower corolla lip. Similar to both species in its prostrate habit, 5-lobed calyces, and fimbriate corolla lobes.

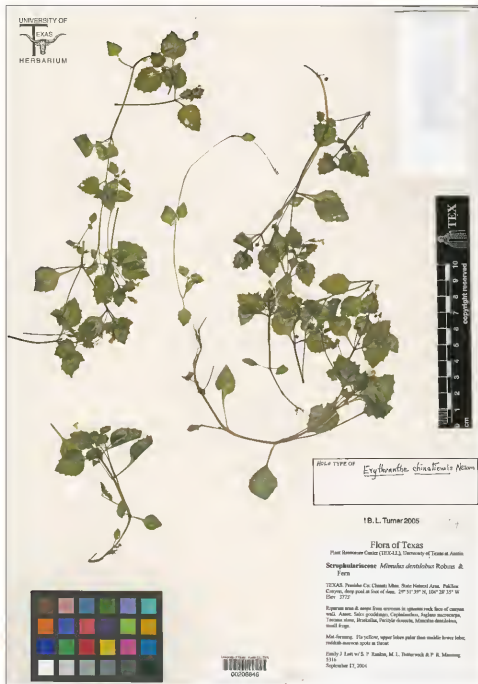
**Perennial**, rhizomatous, mat-forming. **Stems** prostrate, 5–20 cm, sometimes rooting at the nodes, glabrous. **Leaves** cauline, petiolate, blades ovate to broadly ovate or orbicular-ovate, 4–15(–22) mm × 4–15(–18) mm, palmately 3–5(–7) veined, glabrous to moderately villosulous adaxially with vitreous, flattened, eglandular or minutely gland-tipped hairs, glabrous abaxially, margins shallowly denticulate or merely mucronate to mucronulate with 3–6 teeth per side, apices acute to obtuse, bases truncate to cuneate, petioles 2–10(–20) mm. **Flowers** axillary, few and scattered at distal nodes. **Fruiting pedicels** 10–20 mm, glabrous. **Fruiting calyces** ellipsoid, 5–6 mm, closing, nodding 45°–90°, 5-lobed, glabrous to sparsely villosulous-glandular. **Corollas** yellow, red-dotted, tube-throats funnellform 7–8 mm, exserted 4–5 mm beyond calyx margin, limb bilabiate, expanded 6–7 mm (pressed), lobes fimbriate. **Plesiogamous**; anther pairs barely separated in level and essentially contiguous, stigma even with upper anther pair.

**Flowering** Mar–Sep. **Seeps** in vertical cliff faces, wet bluffs; 900–2300 m; Texas (Presidio Co.). Map 23.

**Additional collections examined.** **USA. Texas. Presidio Co.:** S side of Chinati Peak, locally common perennial herb in moist shaded area near seep spring, igneous soils, ca. 6900 ft, 7 Jun 1977, Butterwick & Lott 3784 (TEX); near falls in Mexican Canyon, 27 Nov 1942, Hinkley 2645 (SRSC); S side of Bofecillos Mts., under overhanging rock where water drips continually in Tapada Creek, ca. 2700 ft, 4 Mar 1944, Hinkley 2918 (SRSC); S Chinati Mts., right fork of Tinaja Prieta Canyon, in moist soil of perennially wet seep, with mosses and *Aquilegia*, 15 Apr 1978, Lott 58 (SRSC); Chinati Mountains State Natural Area, Pelillos Canyon, deep pool at foot of dam, riparian area and seeps from crevices in igneous rock face of canyon wall, 3775 ft, mat-forming, 17 Sep 2004, Lott 5316 (SRSC); Chinati Mountains State Natural Area, Pelillos Canyon, between the dam and Tinaja Prieta fork, canyon bottom woodland of *Salix*, *Juglans*, *Cephalanthus*, and *Quercus*, 3910 ft, 25 Mar 2005, Lott et al. 5449 (TEX); near head of trail between Barnett Bros. ranch on Horse Creek and S side of Chinati Mts., hanging in mats vertically permanently wet cliffs, ca. 2000 m, flrs apparently 4-lobed, the upper lobe broad, 21 Jul 1945, McVaugh 7472 (LL, SMU); Big Bend State Park, Tapado Canyon, 2963 ft, 6 Mar 2009, Morey color photo (SRSC); Mexicano Falls and 0.5 air mi SE in Arroyo Segundo, Big Bend Ranch, wet, mossy cliff face, locally common decumbent perennial, corolla yellow, 27 Aug 1984, Poole 2568 (TEX); Chinati Peak and canyons N and E of the peak, overhanging and seeping bluffs, mat-forming succulent, flowers yellow with red spot on lower, larger petal, 7 Jun 1977, Powell & Powell 3095 (LL, SRSC); Tapado Canyon below Redford, limestone soil, sparse on slopes, 5 Feb 1960, Warnock 19100 (SRSC); mid-slopes of Chinati Peak, rare at limestone seep, 5700 ft, 27 Mar 1959, Warnock & Powell 17779 (SRSC).

The leaves of the type collection are at the upper range of variation in size measured for the species.



Figure 12. *Erythranthe chinatiensis*, holotype TEX

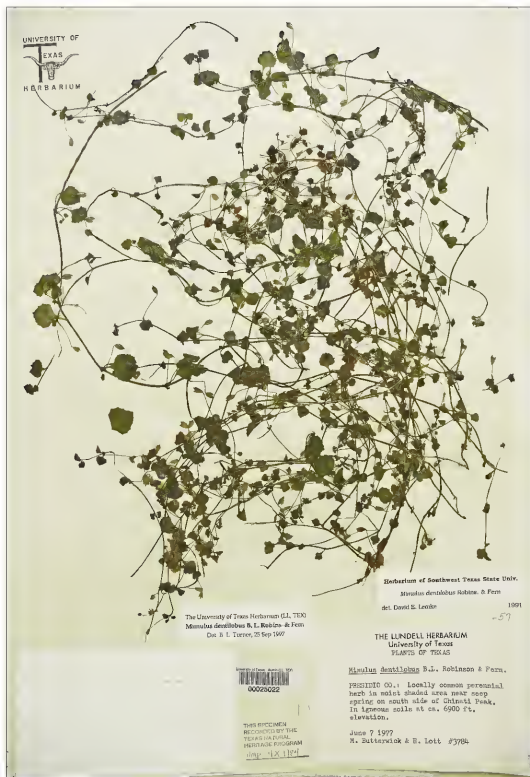


Figure 13. *Erythranthe chinatiensis*, Butterwick & Lott 3784, TEX.



Figure 14. *Erythranthe chinatiensis*. Big Bend Ranch State Park, Tapado Canyon, 2963 ft, 6 Mar 2009. Photograph by Roy Morey, mounted on herbarium sheet at TEX.

35. **ERYTHRANTHE MADRENSIS** (Seem.) Nesom, Phytoneuron 2012-40: 44, 2012. *Mimulus madrensis* Seem., Bot. Voy. Herald 9: 322, plate 58. 1856. **TYPE: MEXICO. [Durango].** In swamps, on the road from Durango to Tepic," 1850, *B. Seemann 2110* (holotype: K, fide Pennell 1935; apparent isotype: BM fide Vickery 1973). The illustration in the protologue (Fig. 11 in the present account) shows the diagnostic features, including the 3-lobed calyx. The relatively long corollas and protruding style, suggestive of allogamy, are similar to *E. pallens*, but the narrowly expanded limb, short pedicels, and small leaves are those of *E. madrensis* as described here. Fig. 11.

*Mimulus wiensti* Vickery, Madroño 22: 161. 1973. TYPE: MEXICO. Durango. W of El Salto, on wet banks near KM 1155 on the Durango-Mazatlan road, 2615 m, 24 Aug 1959, *D. Wiens* 2643, voucher for  $n = 16$  (holotype: UT digital image; isotype: UT digital image!).

**Perennial**, rhizomatous, mat-forming, all parts glabrous, stems and leaves (abaxially) commonly purplish. **Stems** prostrate to decumbent, rooting at the nodes, 5–12 cm, often ascending to ascending-erect or erect in the inflorescence. **Leaves** mostly cauline, broadly ovate to orbicular-ovate, blades 2–10 x 2–8 mm, palmately 3–5-veined, bases cuneate to truncate, apices mostly obtuse, margins shallowly dentate to mucronate, 2–6 teeth per side, adaxial surfaces minutely punctate, all petiolate, petioles 1–6 mm. **Flowers** 1–5(–7), mostly at distal nodes. **Fruiting pedicels** 5–30 mm. **Fruiting calyces** ovoid, 5–8 mm, closing, nodding, lobes usually 3, sometime the 2 middle lobes slightly developed or represented by a mucro at veins end, apices mostly rounded. **Corollas** yellow, red-dotted, tube-throats narrowly funnellform, 5–9 mm, exerted 2–4 mm beyond calyx margin, limb bilabiate, expanded 6–10 mm (pressed). **Plesiomagamous**; anther pairs barely separated in level and contiguous, stigma at same level as upper anther pair. **Capsules** 2.5–3 mm.  $2n = 16$ .

**Flowering** Mar–Aug. Wet crevices, ledges, cliff faces, seepage in road cuts, rocks at waterfalls and in streams, stream banks, moist banks and ditches; (1000–)1500–2800(–3300) m. Mexico (Chihuahua, Durango, Jalisco, Michoacan, Sinaloa, Sonora). Map 24.

Additional collections examined. MEXICO. Chihuahua. Mpio. Batopilas-Mpio. Urique, between Basogochi and Quirare in pine-oak forest near small stand of *Abies durangensis*, small clumps in rock crevices along arroyo, 6870 ft, 3 Jun 1978, *Bye* 8570 (TEX); Mpio. Guachochi-Mpio. Urique, S side of Barranca del Cobre between Napuchi and Rio Urique near KM 69.6 of Creel-Guachochi road in open pine-oak forest, along moist seepage area of road cut, forming mat on perpendicular moist soil surface, 31 May 1980, *Bye* 9725 (TEX); shallow canyon (Arroyo El Reventon?), below Sagaribo, just below cascada, on rocks under cascada, 1600 m, 17 Mar 1992, *Fishbein* 158 (ARIZ); Sierra des Papas, Son-Chi, rock in flowing water, 20 Oct 1933, *Gentry* 641M (ARIZ); Sierra Charuco, Arroyo Hondo, igneous rocky canyon slope in pine-oak forest, seep, 4500–5500 ft, 16–30 Apr 1948, *Gentry* 8159 (ARIZ, UC); Mpio. Temosachi, Nabogame, 12 km NW of Yepachic, in stream, 1800 m, 1 Nov 1986, *Laferriere* 347 (ARIZ); Mpio. Temosachi, Nabogame, trailing, pine-oak-cypress forest, arroyo, 1800 m, 21 Mar 1988, *Laferriere* 2262 (ARIZ, TEX); Cascada Basaseachic, top of falls, ashy volcanic rocks, 1900 m, 17 Mar 1986, *Martin et al.* s.n. (ARIZ); 80 km SW of El Vergel on road to Guadalupe y Calvo, 3.2 km S of bridge in Turuachi, deep canyon, area of pines and oaks, abundant on wet rocks around seepage, ca. 2600 m, 26 Aug 1983, *Nesom* 4971 (TEX); Barranca del Cobre, ca. 54 mi S of Creel and 6 mi SW of the road intersection at Cafe La Casita on the road to La Bufa, vicinity of Basigochi, pine-oak woodland on mountain slope of volcanic ash, 7500 ft, locally common perennial, 22 Mar 1984, *Sanders* 4772 (UC-2 sheets); Mpio. Ocampo, canyon to S of fall, thin soil over wet, slick rock along river, 26 Apr 1985, *Spellenberg et al.* 8007 (NMC); Parque Nacional de Cascada Basaseachic, in the box canyon at the base of the falls, matted on river bank at base of falls, ca. 1700 m, 26 Apr 1986, *Spellenberg et al.* 8448 (NMC); Parque Nacional de Cascada Basaseachic, in the barranca at the base of the falls, in wet clayey soil near base of cliffs, 1570 m, 25 Apr 1987, *Spellenberg et al.* 9058 (NMC). Durango. Sierra Madre Occidental, between Mazatlan and Durango, 2 mi E of El Espinazo, 8600 ft, 8 Jun 1962, *Hutchinson* 2507 (UC); 12.5 mi W of La Ciudad, rocky seepage bluff, 8050 ft, 22 Jul 1975, *LeDoux et al.* 2032 (LL); 39 road mi SW of El Salto on Hwy 40, dripping wet granitic seepage cliff ca. 50 mi high, ca. 2400 m, 21 Jul 1969, *Marcks & Marcks* 1204 (LL); 21.7 mi NE of El Paraiso, Sinaloa, on road between Villa Union and El Salto, wet ledge in seepage, 8400 ft, 29 Sep 1953, *Ownbey* 1982 (UC); 3.4 mi E of El Palmito, 2 Apr 1970, *Powell & Turner* 1866 (TEX); along Mex Hwy 40, 2 mi W of Las Bancos and 22 mi E of El Palmito, 13 mi W of La Ciudad, steep dripping cliffs and slopes along and above road, 27 Sep 1973, *Reveal* 3548 (TEX); 111 road mi N of Santiago Papasquiaro on road to Topia, 5 mi W of Cienega Nuestra Señora, pine-oak-madrone-juniper woods, 2420 m, shaded creek

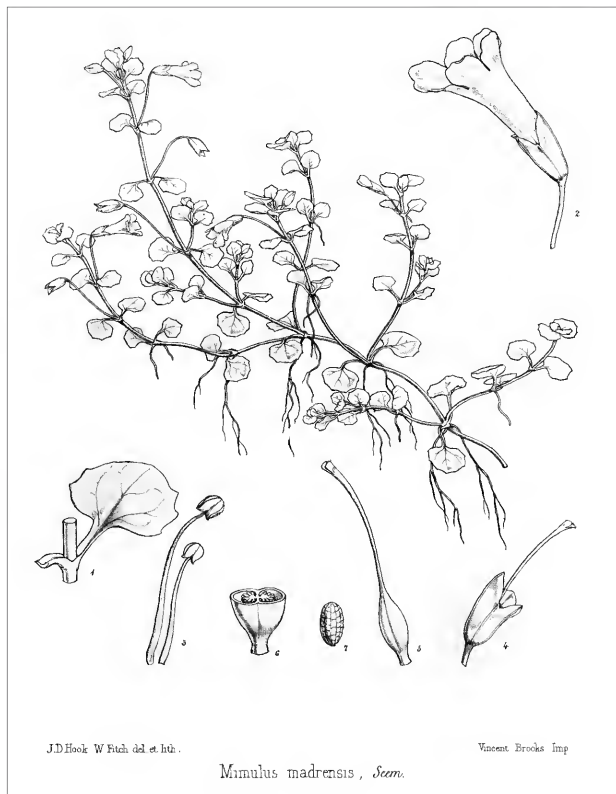


Figure 15. *Erythranthe madrensis*, line drawing from the 1856 protologue.

bank and gravelly creek bed, 18 Sep 1982, *Spellenberg 6711* (NMC); Mpio. Mezquital, 37 km SW de Mezquital, en lugares con mucha humedad, bosque de encino-pino con *Arbutus*, 2450 m, 6 Mar 1985, *Tenorio L. 8078* (ARIZ); crest of the Sierra Madre, ca. KM 177 on Hwy 40, ca. 32 km W of La Ciudad, wet roadside ditch, ca. 2185 m, 12 May 1976, *Vickery 2903*, cult. 12,220 (SRSC, UC); roadcuts on steep mountainside, Hwy 40 just W of La Fragueta, 1.1 mi E of turnout to El Indio (13.2 mi E of the Sinaloa border, ca. 2400 m, 16 Mar 1983, *Whittmore 83-023* (TEX). Jalisco. Mpio. Mezquitic, 15 km después de bajío del Tule hacia Bolanos, postrada, en colonias donde obscure el agua de un manantia, 12 Mar 1991, *Chazaro & Sorensen 6574* (TEX); NE slopes of Nevado de Colima, above Canoas de Leoncito, steep mountain sides in alder-zacaton zone, 3100–3300 m, 13 Sep 1952, *McVaugh 12896* (MICH, SMU!, US). Michoacan. Distr. Coalcoman, Barroloso, bank of stream, 2250 m, 20 Oct 1939, *Hinton 15349* (ARIZ, LL, MO, TEX); near El Barroloso, *McVaugh 22835* (MICH, US); Mpio. Tzitzio, 3 km al S de Mil Cumbres camino a Villa Longin, 2500 m, hierba postrada sobre rocas, en ladera humeda, 11 Oct 1983, *Martinez S. 4811* (MO); just E of Morelia along hwy (KM 212.3), dense patch on vertical, mossy, dripping bank, 23 Aug 1976, *Wonderly 347* (NMC). Sinaloa. Sierra Monterey, Quebrada de Platano, moist cliffs by waterfall, canyon in oak forest, 3000 ft, 12 Mar 1940, *Gentry 5909* (ARIZ); Sierra Surotato, Los Pucheros, rocky stream bank, openly forested slope of pine-oak-madrone, 5500–6500 ft, 17–24 Mar 1945, *Gentry 7213* (ARIZ, UC); Sierra Suotato, above La Jolla, riparian, pine-oak zone, 5000–6000 ft, 17–24 Mar 1945, *Gentry 7285* (ARIZ). Sonora. Canada La Ventana (Arroyo El Otro Lado), 2.5 km (by air) ESE of Yecora, rocky stream canyon in pine-oak forest, 1520 m, moist bank above stream, 1 Oct 1998, *Reina G. 98-1991* (ARIZ).

*Erythranthe madrensis* is distinct in its prostrate stems forming mats, small, petiolate leaves with minutely punctate adaxial surfaces and usually purplish abaxially, glabrous vestiture, 3-lobed calyces, and small, bilabiate but autogamous flowers.

36. **ERYTHRANTHE PALLENS** (Greene) Nesom, *Phytoneuron* 2012-40: 45. 2012. *Mimulus pallens* Greene, *Leaf. Bot. Observ. Crit.* 2: 4. 1909. TYPE: MEXICO. Durango. Santiago Papasquiaro, Apr-Aug 1896, *E. Palmer 55* (holotype: US digital image! photo-PH!, photo-UC!; isotypes: MO!, NY digital image!, UC!).

*Mimulus yecorensis* Vickery, *Madroño* 44: 391. 1997 [publ. 1998]. TYPE: MEXICO. Sonora. 17 km E of Yecora on Mexico Hwy 16, mossy banks of small stream in pine forest, 26 Apr 1982, *D.A. Polhemus s.n.* [Vickery culture no. 13257] (holotype: UT!; isotypes: CAS digital image!, GH, MICH digital image!, MO!, NY digital image!, SRSC!, UC!, US digital image!). Voucher for chromosome count of  $n = 32$ . Vickery (1973, 1997) studied the type of *Mimulus madrensis* (he stated that he borrowed material from K) and placed it as a synonym of *M. glabratus* var. *fremontii*.

**Annual**, fibrous-rooted, rhizomatous, sometimes mat-forming, all parts glabrous, stems and leaves (abaxially) sometimes purplish. Stems procumbent to decumbent, 3–18 cm commonly rooting at the nodes, ascending to ascending-erect in the inflorescence. Leaves basal and cauline, 1–3(–4) pairs, basal short-petiolate (petioles 1–2 mm), sessile distally, blades broadly elliptic to ovate-elliptic or suborbicular, 4–12 x 3–9 mm, adaxial surfaces minutely punctate, bases cuneate to truncate-rounded, apices rounded, margins shallowly crenate to dentate with 2–6 teeth per side. Flowers 1–6(–8), from all nodes to mostly distal nodes. Fruiting pedicels 25–50 mm. Fruiting calyces campanulate-ovoid, 6–10 mm, closing, nodding 30–90°, lobes 3, apices, rounded. Corollas yellow, red-spotted in the floor of throat and tube, tube-throats narrowly funnelliform, 8–12 mm, exerted 3–5 mm beyond the calyx margin, limb bilabiate, expanded 8–12 mm (pressed). Herkogamous; anther pairs at different levels, stigma above the upper anther pair. Capsules 2.5–3.5 mm.  $2n = 32$ .

Flowering Mar–Sep. Wet rocks at waterfalls and in streams, stream banks, springs, shady wet ravines; 1250–2700 m. Mexico (Chihuahua, Durango, Sinaloa, Sonora). Map 24.

Additional collections examined. MEXICO. Chihuahua. NE slope of Sierra Mohinora, in wet soil along stream (tributary of Río del Soldado) in gorge of conifer forest, near La Rocha, 7500 ft, 14-15 Oct 1959, *Correll & Gentry 23097* (LL); Mpio. Temosachi, Nabogame, pine-oak-*Cupressus arizonica* forest, 1800 m, 3 Dec 1987, *Laferriere 1288* (NMC); Mpio. Ocampo, area of Cascada de Basaseachic, steep-sided canyon of Río Durazno, S of parking area and campground, ca. 1950-2000 m, edge of pool along riverbank with cover of other herbs, 17-20 Oct 1986, *Nesom & Vorobik 5618* (TEX); Barranca del Cobre, ca. 54 mi S of Creel and 6 mi SW of the road intersection at Café La Casita on the road to La Bufa, vicinity of Basigochi, pine-oak woodland on mountain slope of volcanic ash, 7500 ft, locally common perennial, 22 Mar 1984, *Sanders 4772* (UC-2 sheets); 24 km from Creel and along roadside to and at the Cascadas de Cusarare, on wet rocks at the base of a waterfall, 7140 ft, 26 Aug 1990, *Swagel 253* (MO); near Colonia García in the Sierra Madres, 7400 ft, 12 Sep 1899, *Townsend and Barber 324* (MO); Mpio. Ocampo, Cascada de Basaseachic, bosque de pino-encino, 1250 m, 14 Apr 1995, *Yen & Estrada 4119* (BRIT) and *4129* (BRIT). Durango. Distr. Santiago Papasquiaro, NE of Ataés, on rocks in brook, pine forest, 8000 ft, 20 Apr 1943, *Lundell 13019* (LL-2 sheets); San Ramón, Apr 21-May 18 1906, *Palmer 87* (MO, UC); 111 road mi N of Santiago Papasquiaro on road to Topia, 5 mi W of Ciénega Nuestra Señora, pine-oak-madrone-juniper woods, 2420 m, shaded creek bank and gravelly creek bed, 18 Sep 1982, *Spellenberg 6712* (NMC). Sinaloa. Sierra Surotato, Los Pucheros, riparian in pine-oak-madrone forest, 5500-6500 ft, 17-24 Mar 1945, *Gentry 7232* (ARIZ, UC). Sonora. 11 mi E of Yecora, along road between Yecora and Maicova, on bank of small stream, with *Pinus latifolia* and *Pinus chihuahuana*, 5200 ft, 27 Mar 1975, *Karpiscak 75-16* (ARIZ); Hwy 16 to Yecora, *Platamus* spring, 1700 m, 13 Mar 1990, *Martin & Ferguson s.n.* (ARIZ); 5.2 km W of Yecora on Mex 16, pine-oak forest, 1720 m, in moist soil near stream, 11 Mar 1996, *Van Devender 96-93* (ARIZ).

*Erythranthe pallens* (tetraploid) is similar to *E. madrensis* (diploid) in its mat-forming habit, glabrous vestiture, and punctate adaxial leaf surfaces but differs in its longer pedicels, larger calyces, longer corollas with broader limbs, and its allogamous fertility. The two have nearly congruent geographic distributions except that *E. madrensis* is mapped here further south (but see comments below). A hypothesis of autopolyploid origin for *E. pallens* is plausible except for the presumably more specialized autogamous fertility of the putative ancestor (*E. madrensis*).

Apparently closely adjacent colonies of *Erythranthe pallens* and *E. madrensis* were recognized in the field as distinct by Spellenberg in north-central Durango. His 6712 (*E. pallens*) was described as "corollas yellow" and has fruiting pedicels 15-30 mm and corolla tubes 9-10 mm with limbs expanded 10-12 mm; the flowers are allogamous. His 6711 (*E. madrensis*) was described as "corollas yellow, red-spotted within" and has fruiting pedicels 12-25 mm and corolla tubes 6-7 mm with limbs expanded 6-8 mm; the flowers are autogamous.

The close similarity of these entities is emphasized by variability in *Erythranthe madrensis* that approaches *E. pallens*. A greenhouse-grown plant of *E. madrensis* from seeds collected along Hwy 40 west of La Ciudad, Durango (*Vickery 2903*, UC!), has nearly the same aspect as *E. pallens* (large leaves, long pedicels, and relatively larger) but still has autogamous corollas. *McVaugh 12896* from Nevado de Colima in Jalisco is identified here as *E. madrensis* but is larger than normal (fruiting calyces 8 mm, fruiting pedicels 15-30 mm, corolla tubes 9-10 mm, exerted 4-5 mm). *Wonderly 347* from Michoacán also is identified as *E. madrensis* but has larger corollas and slightly didynamous stamens, the mode of fertility ambiguous from the specimen. The distinction and relationship between the Jalisco and Michoacán collections need further study.



37. *ERYTHRANTHE PENNELLII* (Gentry) Nesom, *Phytoneuron* 2012-40: 45. 2012. *Mimulus pennellii* Gentry, *Madroño* 9: 24. 1947. TYPE: MEXICO. Sinaloa. Africa, Sierra Tacuichamona, on rocks in water, 2000–3000 ft, 19 Feb 1940, *H.S. Gentry 5691* (holotype: MICH digital image!; isotypes: ARIZ-2 sheets!, MO!, PH!). The physiography and vegetation in the region of the type locality of *Mimulus pennellii* (Sierra Tacuichamona) were described in detail by Gentry (1946).

Perennial, rhizomatous, often mat-forming; stems, pedicels, calyces, and leaf surfaces moderately to densely villous with vitreous, multicellular, flattened hairs mostly 1–3 mm long with minute, dark-colored gland at the tip of each. Stems ascending-erect to decumbent-ascending, 10–30 cm, rooting at proximal nodes, finely villosulous-glandular to densely villous-glandular. Leaves mostly cauline, blades orbicular to suborbicular, broadly ovate, or depressed-ovate, mostly 5–15(–30) mm x 6–17(–35) mm, largest at the base or near midstem, gradually or slightly reduced in size up to uppermost nodes, moderately to densely villous on both surfaces, proximal sharply cuneate to a petiolar base 1–5(–10) mm, distal becoming sessile, primarily palmately 5-veined with secondary reticulum evident, margins shallowly and regularly dentate to dentate-serrate with 3–6(–10) thick, mucronate-tipped teeth per side, apices mostly rounded. Flowers 2–6, mostly at distal nodes. Fruiting pedicels 15–25 mm, spreading-ascending. Fruiting calyces ovoid, 6–8 mm, closing, nodding lobes 5, triangular-acute, the upper ca. 1–2 times longer. Corollas yellow, red-spotted, tube-throats funnellform, 6–8 mm, exserted 2–3 mm beyond calyx margin, limb bilabiate, expanded 6–8 mm (pressed). Plesio gamous; anther pairs and stigma at essentially the same level. Capsules ca. 3 mm.

Flowering Jan–May. Wet places in canyons, cliff faces, rocks in water, flood plains, riparian forest, oak forest; 300–1500 m. Mexico (Sinaloa, Sonora). Map 25.

Additional collections examined. MEXICO. Sinaloa. [Mpio. Badiraguato], Puerto a Tamiapa, moist bank in canyon bottom, oak forest, 4500 ft, 5 May 1940, *Gentry 5866a* (ARIZ). Sonora. Arroyo Guajaray, Cajón del Ardilla, growing in wet place near mouth of canyon in riparian forest with *Eupatorium collinum*, *Heliocarpus*, *Celtis iguanea*, *Montanoa rosei*, 375 m, 15 Mar 1994, *Fishbein et al. 1569* (ARIZ); Los Conejos, Rio Mayo, Saluchi W, small arroyo, growing in rocks out of which water seeping, 25 Oct 1934, *Gentry 1111* (ARIZ); 10 mi W of Nuri by old road to Texopaco, on small cliff above perennial stream, 24 Mar 1975, *Goldberg s.n.* (ARIZ); 5 km SW of Santa Barbara by road, at the entrance to a cave in El Palmarito canyon, 1000 m, 16 Mar 1990, *Martin s.n.* (ARIZ); ca. 5 km S of Santa Barbara, cave next to Mesa Redonda, 900 m, 14 May 1990, *Martin s.n.* (ARIZ); 1 mi N of Nuri, flood plain of the Rio Nuri, in sand in recent flood channel, 25 Mar 1975, *Spaulding 75-3-41* (ARIZ); below the village of Guajaray on Arroyo Guajaray, 6.5 km (by air) WNW of jet with Rio Mayo, tropical deciduous forest in rocky stream canyon, 270 m, in cobbles near stream, 19 Mar 1993, *VanDevender 93-476* (ARIZ); ca. 1 km (by air) NW of Yecora, along Rio Yecora, 1530 m, in moist soil or recently dried rocky stream beds, 2 Jun 1999, *Van Devender 99-181* (ARIZ).

Among the species of sect. *Simiola*, *Erythranthe pennellii* is distinctive in its combination of decumbent stems rooting at the nodes and forming mats, stipitate-glandular to villosulous-glandular or villous-glandular vestiture of vitreous, flattened hairs, orbicular to broadly ovate leaves with regularly dentate margins and short petioles, consistently 5-lobed calyces with middle lobes often reduced in size, and small corollas and autogamous fertilization.

In its habit, leaf morphology, and geography *Erythranthe pennellii* is most similar to *E. pallens* and *E. calciphila*, meso to *E. calciphila* in its glandular vestiture and small corollas (autogamous). It is distinct from *E. calciphila* in its mostly decumbent stems with adventitious roots, deciduous basal leaves, and consistently 5-lobed calyces.



38. *ERYTHRANTHE CALCIPHILA* (Gentry) Nesom, *Phytoncuron* 2012-40: 43. 2012. *Mimulus calciphilus* Gentry, *Madroño* 9: 2. 1947. TYPE: MEXICO. Sinaloa. Sierra Surotato, Los Pucheros, pine-oak-madrone, openly forested slope, 5500–6500 ft, calcareous peñasco, shady slope, 17-24 Mar 1945, H.S. Gentry 7217 (holotype: MICH digital image!; isotypes: ARIZ!., F digital image!, PH!).

*Mimulus minutiflorus* Vickery, *Madroño* 44: 392. 1997. TYPE: MEXICO. Durango. Km 165.5 on Mexico Hwy 40, in ephemeral moist, sunny areas in the pine forest, 2220 m, 12 May 1976, R.K. Vickery, Jr. 2901 [Vickery culture no. 12,218] (holotype: UT!; isotypes: CAS digital image!, GH, MICH digital image!, MO! digital image!, SRSC!, UC!, UT!). Voucher for  $n = 32$ . Types distributed by Vickery were from greenhouse-grown plants that were rooting at lower nodes -- atypical in nature but seen in a few other collections besides the type.

**Annual**, usually fibrous-rooted, without rhizomes or stolons; stems, pedicels, and calyces minutely stipitate-glandular. Stems usually erect, sometimes decumbent-ascending, 4–30 cm, rarely rooting at proximal nodes, delicately villous-glandular along the whole length. Leaves basal and cauline, all petiolate, palmately 3(–5)-veined, blades orbicular-ovate to oblong-ovate, 7–28 mm x 5–22 mm, margins shallowly dentate to denticulate with 3–6 teeth per side, apices rounded to obtuse, base truncate to shallowly cuneate; petioles 1–3 mm, cauline blades slightly or hardly reduced in size from the basal but becoming subsessile to sessile (1–3 pairs of cauline leaves), surfaces villous with thin-walled, vitreous, eglandular or minutely gland-tipped hairs, commonly also minutely stipitate-glandular. Flowers 1–6(–10), axillary at all nodes. Fruiting pedicels 15–30(–55) mm, sometimes minutely hirtellous and minutely stipitate-glandular, sometimes short glandular-villous. Fruiting calyx ovoid, 5–6 mm in flower, 6–10 mm in fruit, thin, usually 3(–5)-nerved, closing, nodding ca. 90° at maturity, lobes usually 3 or 3 and 5 on the same plant, if 5 then with the 2 interpolated lobes much smaller than the lower pair. Corollas light yellow, red-spotted, tube-throats narrowly funnelform, 5–7 mm, exserted 1–2 mm beyond calyx margin, limb barely bilabiate, expanded 2–4 mm. Styles glabrous. Plesiomorphic; anther pairs and stigma at essentially the same level. Capsules 2–4 mm, stipitate, included.  $2n = 30, 32$ . Figs. 12, 13.

Flowering Mar–Sep(–Nov). Rocky knobs, moist boulders, wet rock faces, road cuts, seepage, springs, usually in pine or pine-oak woods; 1800–2500 m; Arizona; Mexico (Chihuahua, Durango, Sinaloa, Sonora). Map 25.

Additional collections examined. USA. Arizona. Cochise Co.: Mule Mts., Bisbee, wet places, Apr 1909, Goodding 52 (ARIZ); Huachuca Mts., Glance Canyon, moist spot under rock ledges, 29 Sep 1949, Goodding 874-49 (ARIZ); Bisbee, in creeks, Apr 1909, Harris 21 (ARIZ); Chiricahua Mts., Cave Creek Canyon, 22 Sep 1929, Harrison *et al.* 6186 (ARIZ); Chiricahua Mts., Coronado Natl. Forest, 1/8 mi W of Rustler Park Ranger Station, along Bootlegger Trail (USFS Trail 257) to Long Park, on moist rock faces of granite boulders, continual water supply from seepage, nearly total shade of *Pinus ponderosa*, assoc. flora of Douglas fir, gambel oak, aspen, *Salvia*, *Artemisia*, *Senecio*, *Bromus*, 8400 ft, 11 Sep 1986, Ward 86-062, voucher for chromosome count of  $n = 15$  (MO). MEXICO. Chihuahua. Cerro Quicorichi, Rio Mayo, riparian, on moist rocks above water, 6000 ft, 6 Oct 1935, Gentry 1941 (ARIZ); canyon E of Hidalgo del Parral, seepage at foot of dam, 12 Nov 1957, Knobloch 749 (LL); Mpio. Temosachi, Nabogame, pine-oak-*Cupressus arizonica* forest, 1800 m, 21 Mar 1988, Laferriere 1394 (TEX); Mpio. Guadalupe y Calvo, meadow on S side of village of Turuachi, 0.4 mi NW of bridge crossing in Turuachi, SW of Rio Verde 46 mi SW of El Vergel, area of pine and scattered oaks, 22 Aug 1988, McDonald & Nesom 2526 (TEX); Sierra Obscura, 1 mi W of Rancho El Oso, 2000 m, 26 Mar 1985, Martin *s.n.* (ARIZ); 49.9 mi SW of El Vergel on Hwy 24, in Turuachi Canyon, 0.7 mi S of bridge at Turuachi, area of oak-pine, base of N-facing slope/seepage area, scattered on vertical, wet rock face of road cut below seepage area, 2200 m, 24 Aug 1984, Nesom & Lewis 5141 (TEX); Santa Rosa, 30 May 1960, Pennington 256 (TEX); Sierra Madre, springy places, 29 Sep 1887, Pringle 1347 (ND-Greene); Mpio. Ocampo, 8 mi toward San

Juanito from jet of Tomochic-Yepachic road, 7 mi NW of Yoquiva, steep N slope, igneous, with *Quercus sideroxyla*, *Q. rugosa*, doug fir, ca. 8000 ft, 27 Apr 1985, *Spellenberg et al. 8061* (NMC); Mpio. Ocampo, ca. 1 km W of W boundary of Parque Nacional Cascada de Basaseachic, 21 km from the Cahuisori-Ocampo road on the road to Candameña, 10.5 km below Cruz Verde at the crossing of the Rio Candameña, ca. 1.6 air mi N of Candameña, among *Platanus*, *Acacia*, 965 m, two plants only on a sand bar, 25 May 1994, *Spellenberg & Miller 12062* (NMC); Mpio. Ocampo, ca. 1 km W of W boundary of Parque Nacional Cascada de Basaseachic, 11 km from the Cahuisori-Ocampo road on the road to Candameña, 0.3 km below Cruz Verde, steep SE-facing canyon at the top of Barranca Comosante, oaks, 1900 m, in seep in cleft in rock, 23 Sep 1994, *Spellenberg et al. 12125* (NMC); 18 air km SSE of Cuahtemoc, above Cuisuiriaichic at mine, on La Bufa, vertical rock face, among wet moss, 6800 ft, 14 Apr 1984, *Spellenberg & Soreng 7704* (NMC); Sierra La Brena, 13 mi SW of Altamirano, just W of Los Azules on high rocky knob in pine-oak woodland, 7200-7400 ft, 26 Sep 1998, *Spencer & Atwood 1244* (TEX); Mpio. Ocampo, road to Candameña, 5 km before Cruz Verde, open, rocky, NE-facing slope, 6000 ft, 23 Sep 1994, *Todsén s.n.* (NMC); 5 mi SE of Colonia García, 12 Sep 1899, [*Townsend & Barber*] 324 (ND-Greene); 20 mi SW of Chuichupa, 31 Aug 1899, [*Townsend & Barber*] 388 (ND-Greene). **Durango.** 25 km E of El Palmito, along highway, steep moist cliff, ca. 2300 m, Mar 1965, *Breedlove 7231*, Vickery cult. 7169, voucher for  $n = "32", 48", 64"$  (SRSC, UC); Santiago Papasquiaro and vicinity, Apr and Aug 1896, *Palmer 55* (UC); 111 road mi N of Santiago Papasquiaro on road to Topia, 5 mi W of Cienega Nuestra Señora, steep, rocky W face, of mesic canyon bottom next to stream, pine-fir-oak-madrone-juniper woods, 2420 m, on mossy rock, 18 Sep 1892, *Spellenberg & Zimmerman 6741* (NMC); KM 165.5 on Mex Hwy 40, in ephemerally moist sunny areas in the pine forest, 2220 m, 12 May 1976, *Vickery 2901*, cult. 12,218, greenhouse grown, voucher for  $n = 32$  (UC); 2 km W of Los Bancos, Hwy 40 at KM 165.5, in moss all over the wet cliffs, 7550 ft, 12 May 1976, *Vickery [2901]*, field-collected (UC-2 sheets). **Sinaloa.** Along Hwy 40, 1.5-3 mi below El Palmito, ca. 45 mi NE of Concordia and ca. 3 mi S of the Durango state line, locally common beside a seep, 6400 ft, 30 Dec 1883, *Sanders et al. 4463* (ARIZ). **Sonora.** Sierra de los Ajos, W-facing slope, spring at head of Hoya del Packard, 2300 m, 10 Oct 1992, *Felger et al. 92-893* (ARIZ); Mesa El Campanero, along road between Puerto de la Cruz and microwave station, ca. 0.4 mi N of microwave tower, 2100 m, seep in side of cliff in pine-oak forest, 9 Sep 1995, *Fishbein et al. 2603* (ARIZ); Mesa El Campanero W of Yecora, headwaters of El Reparo (Yaqui River), fir-*Cupressus-Pinus* ravine, 2100 m, 2 Jul 1992, *Martin & Barber s.n.* (ARIZ).



Figure 16. *Erythranthe calciphila*, *Spencer & Atwood 1244*, from northwestern Chihuahua.

*Erythranthe calciphila* is recognized by its annual duration (fibrous-rooted), short, erect stems with few, even-sized leaves (the basal often persistent), delicate stipitate-glandular vestiture, 3-lobed calyces relatively large in fruit, and very small corollas with autogamous fertilization. Plants rarely root at proximal nodes — an example from Sierra Obscura, Chihuahua (*Martin s.n.*) has the basal portion of the stem rooting at nodes; these plants also have lateral calyx lobes more prominently developed than characteristic for the species.



Figure 18. *Erythranthe calciphila* in natural habitat. Photo by Mark Egger, used by permission. Sinaloa, Mexico, along Mex. Hwy 40, below (and W of) El Palmito, on barranca cliffs, 1 Sep 1997.

**39. ERYTHRANTHE VISIBILIS** Nesom, *sp. nov.* **TYPE. MEXICO. Michoacan.** Vicinity of Morelia, Cerros San Miguel, 2200 m, Dec 1910, *G. Arsene 5310* (holotype: MO). Figure 19.

Distinct among species of sect. *Simiola* in its combination of terrestrial habitat, prostrate stems rooting at the nodes, small, villosulous-glandular leaves, glandular pedicels, tendency for 3-lobed calyces, and tiny, autogamous flowers on short pedicels.

**Annual** (probably; basal parts not observed), mat-forming. **Stems** procumbent, 2–10 cm, rooting at the nodes, glabrous. **Leaves** drying very thin and translucent, cauline, petiolate to subpetiolate, petioles 1–3 mm, blades ovate or ovate-elliptic to depressed-ovate, 5–14 mm x 5–14 mm, palmately 3–5-veined, adaxial surfaces sparsely to moderately puberulous with vitreous, thin-walled, gland-tipped hairs ca. 0.2–0.8 mm, not punctate, margins subentire to barely mucronulate or

shallowly but sharply dentate-serrate, 3–5 teeth per side, apices obtuse to rounded, bases cuneate to subcordate. **Flowers** 1–3, apparently mostly at distal nodes. **Fruiting pedicels** 4–11 mm, minutely stipitate-glandular with hairs ca. 0.1 mm. **Fruiting calyces** broadly obovate-campanulate, 4–6 mm, variably closing or not at all, nodding, lobes 3–5, the middle sometimes much reduced, upper lobe longest. **Corollas** yellow, apparently without red markings, tube-throats cylindric, ca. 5–6 mm, barely exerted if at all beyond the calyx margin. **Plesiogamous**, anther pairs and stigma at essentially the same level. **Capsules** 2–3 mm, included.

Known only from the type collection and one other from the same locality. Map 24

Additional collection examined. **MEXICO. Michoacan** Vicinity of Morelia, Cerros San Miguel, 2200 m, 10 Feb 1912, *Arsene 9936* (MO).



Figure 19. *Erythranthe visibilis*, type collection. Insets contrast mature calyx morphology, closed vs open

The epithet is an affirmation of the existence of these plants, despite their diminishingly small size and delicate aspect. *Erythranthe visibilis* has the smallest flowers of any species in sect. *Simola*. The two collections cited here were annotated by A.L. Grant and by F.W. Pennell as "*Mimulus glabrata* var. *jamesii*" (that entity identified here as *Erythranthe geyeri*). Habitat information is lacking for the collections but the plants are prostrate and mat-forming and in a terrestrial habit, growing intermixed with two species of delicate moss. The calyces are variably 5-lobed to 3-lobed, sometimes with reduced middle lobes (thus tending toward 3-lobed) and the throat also is variable from closed to open, the two lower lobes turning sharply upward or not (Fig. 19).

*Erythranthe visibilis* is a member of the primarily Mexican *E. madrensis* group, particularly in view of the calyx morphology, relatively reduced size, and geography. The range of *E. madrensis* reaches Michoacan (Map 23) and depauperate plants of that species rarely may approach the approximate small size of *E. visibilis*, but nowhere in the range of *E. madrensis* does it produce glandular pedicels or leaves, which are characteristic of *E. visibilis*.

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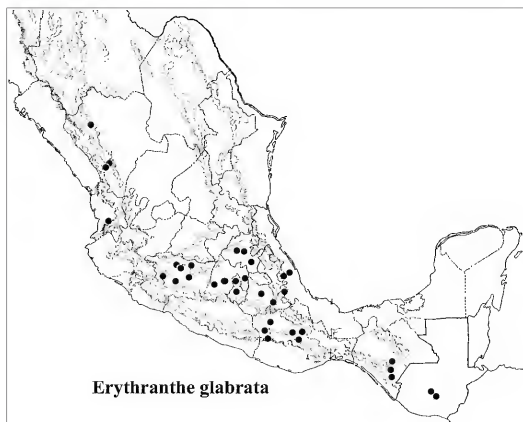


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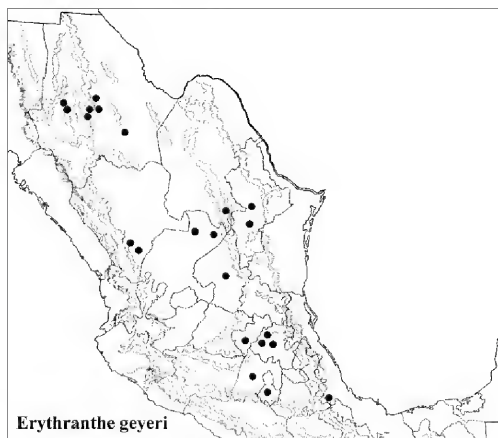
Chromosome counts for sect. *Simiola* (some not cited in text)

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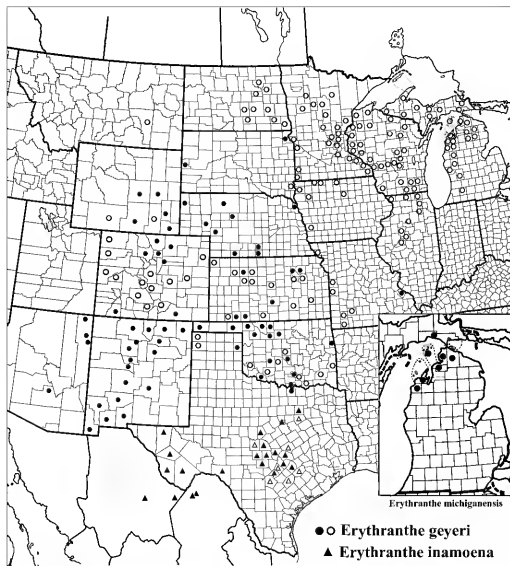
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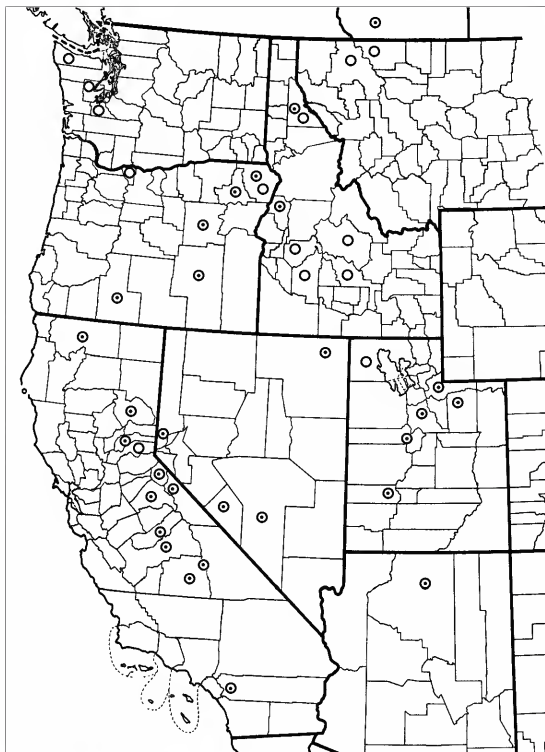
Map 1. Distribution of *Erythranthe glabrata*.



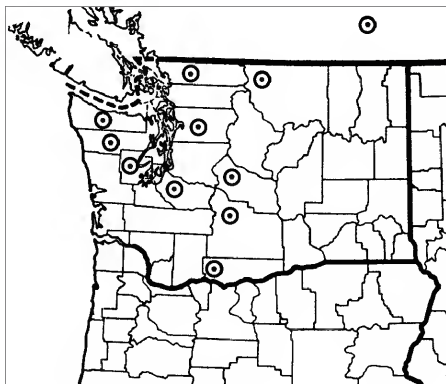
Map 2. Distribution of *Erythranthe geyeri* in Mexico.



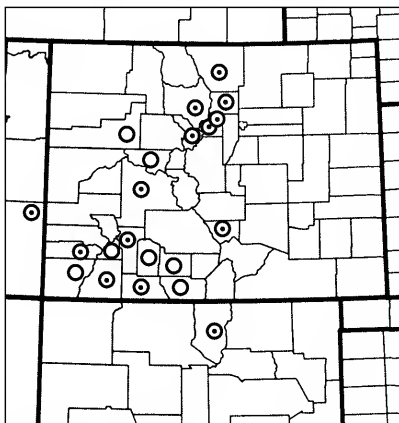
Map 3. Distribution of *Erythranthe mammoena*, *E. geyeri* in the USA, and *E. michiganensis*. Hollow symbols are records from literature. Missouri distribution records for *E. geyeri* added from Weber et al (2000).



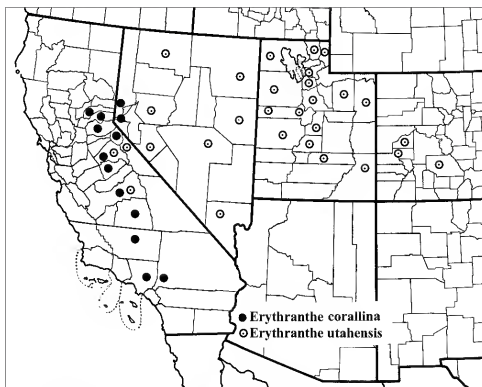
Map 4 Distribution of *Erythranthe tilingii*. Symbols without dots are records from literature



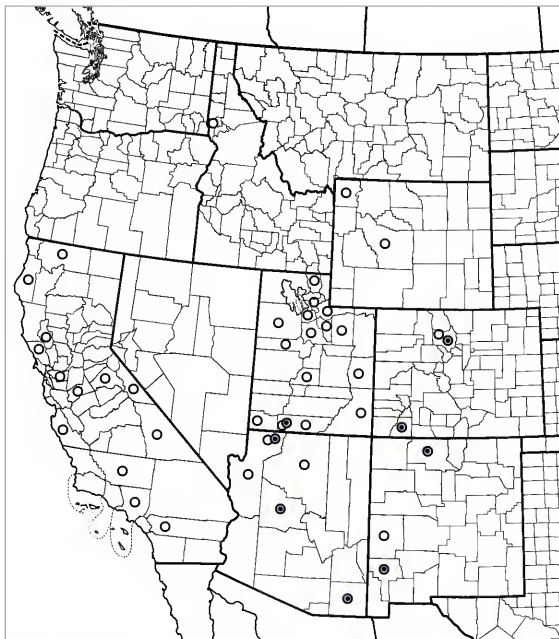
Map 5. Distribution of *Erythranthe caespitosa*.



Map 6. Distribution of *Erythranthe minor*. Symbols without dots are records from literature.

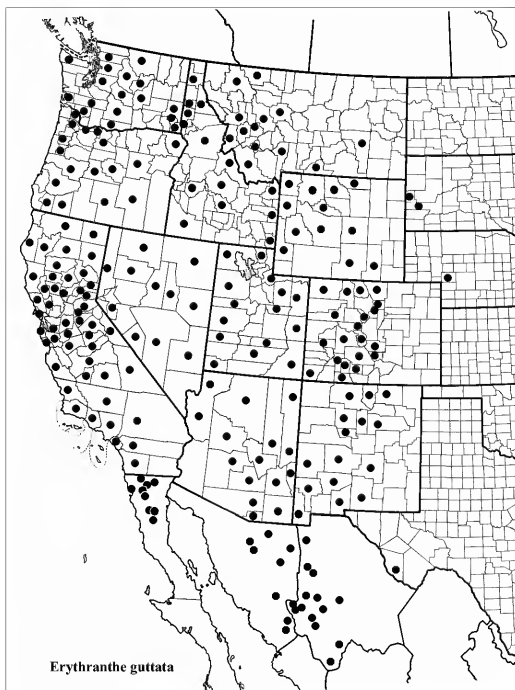


Map 7. Distribution of *Erythranthe utahensis* and *E. corallina*

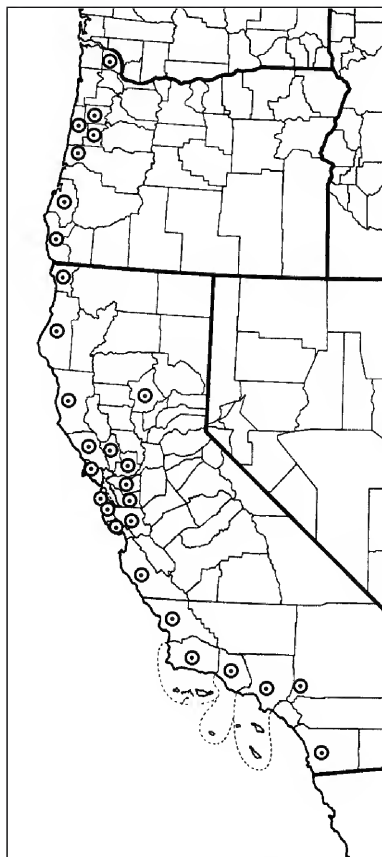


Map 8 Chromosome counts reported from the USA for plants identified as *Mimulus guttatus*. Open circles are diploid, dotted blue circles are tetraploid. Overlapping symbols in Mohave Co., Arizona, and Kane Co., Utah, denote single populations with both ploidy levels. Tetraploids also are reported from Canadian coastal localities (British Columbia) and Alaska. See text for further comments.

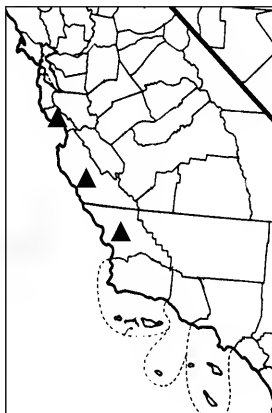




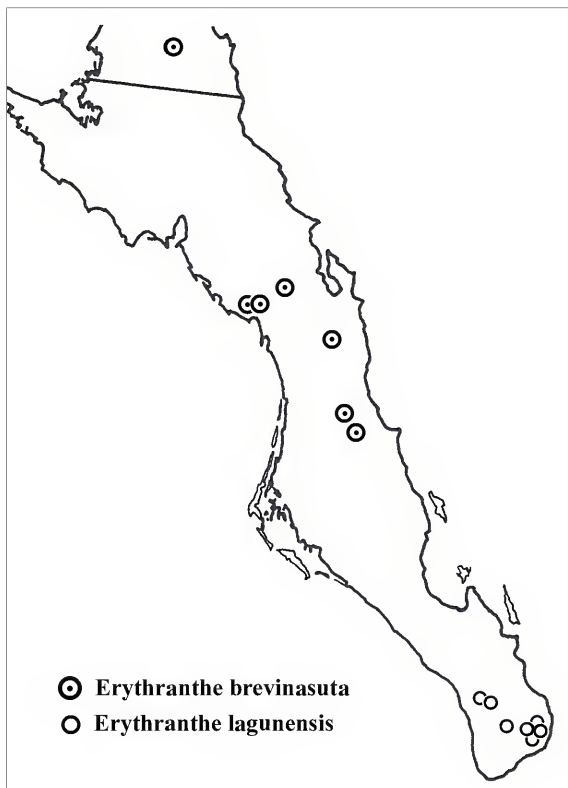
Map 9 Distribution of *Erythranthe guttata* (in the sense of the present study) in the USA and Mexico. The complete distribution in Mexico is shown.



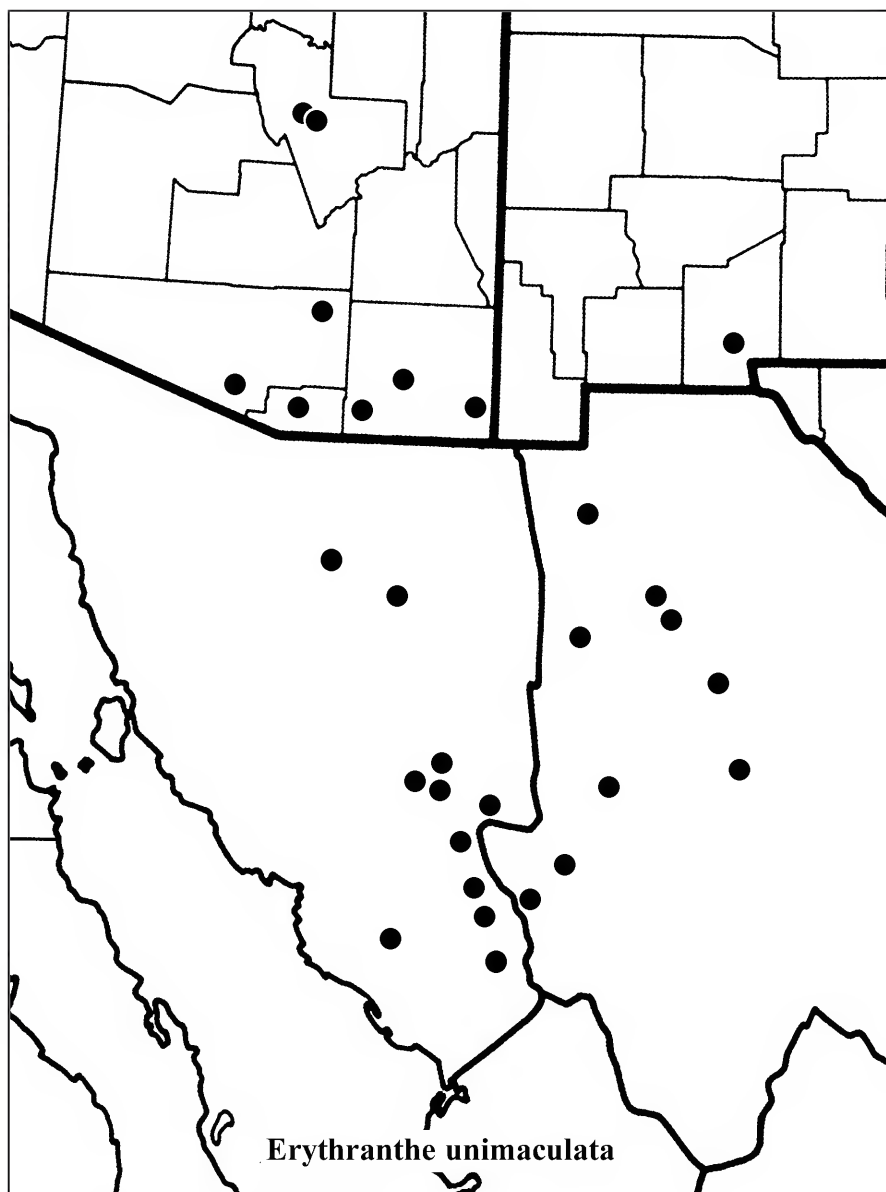
Map 10. Distribution of *Erythranthe grandis*.



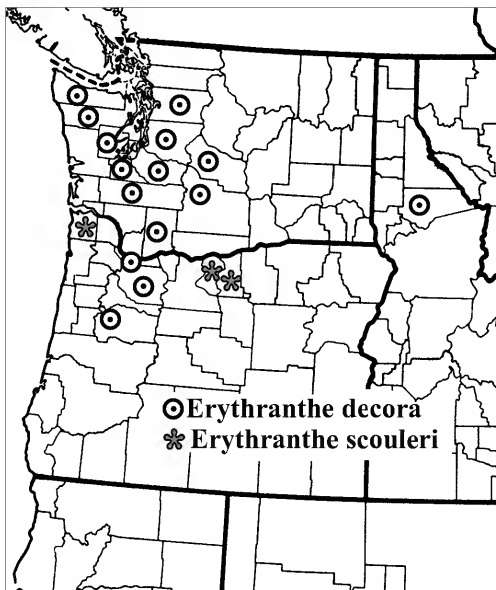
Map 11. Distribution of *Erythranthe aremicola*



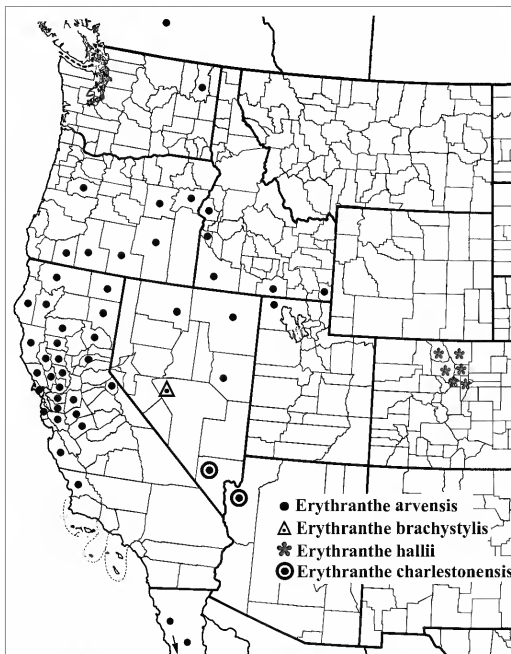
Map 12. *Erythranthe brevinasuta* and *E. lagunensis*.



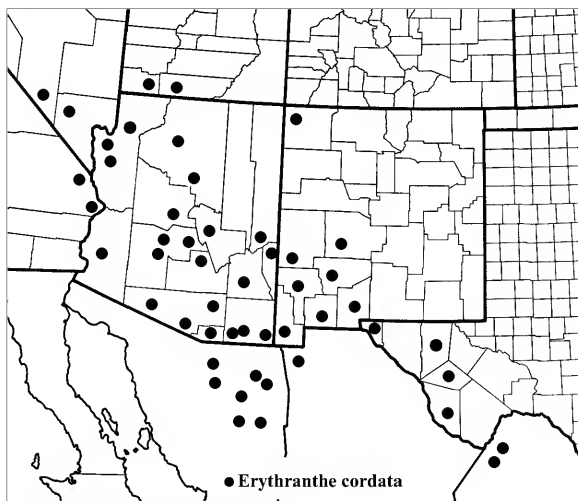
Map 13. Distribution of *Erythranthe unimaculata*.



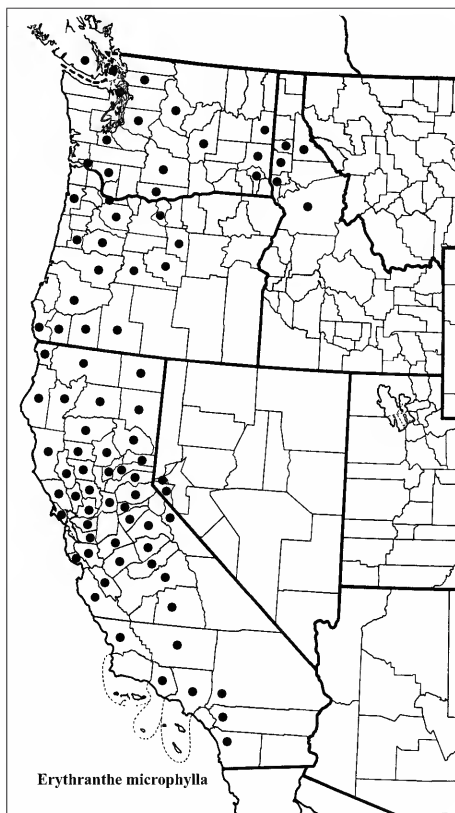
Map 14 Distribution of *Erythranthe decora* and *E. scouleri*



Map 15 Distribution of *Erythranthe arvensis*, *E. brachystylis*, and *E. hallii*. Study of herbaria in Oregon and Washington (under-represented in the current study) may show that *E. arvensis* is more common in that region.

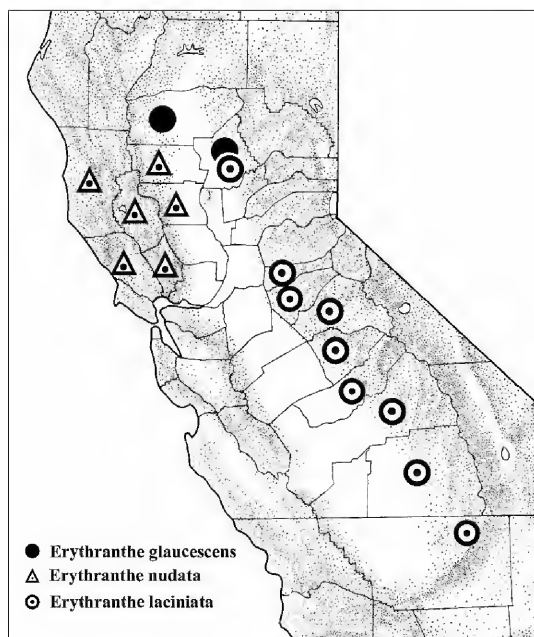


Map 16. Distribution of *Erythranthe cordata*.

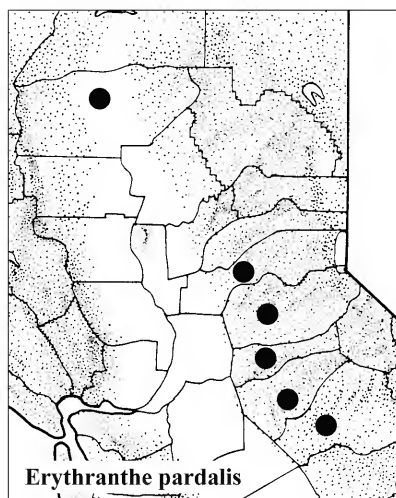


Map 17. Distribution of *Erythranthe microphylla*.

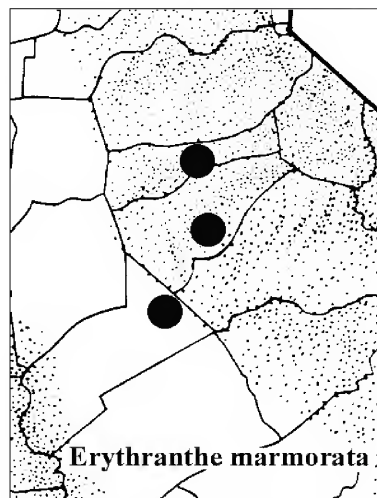




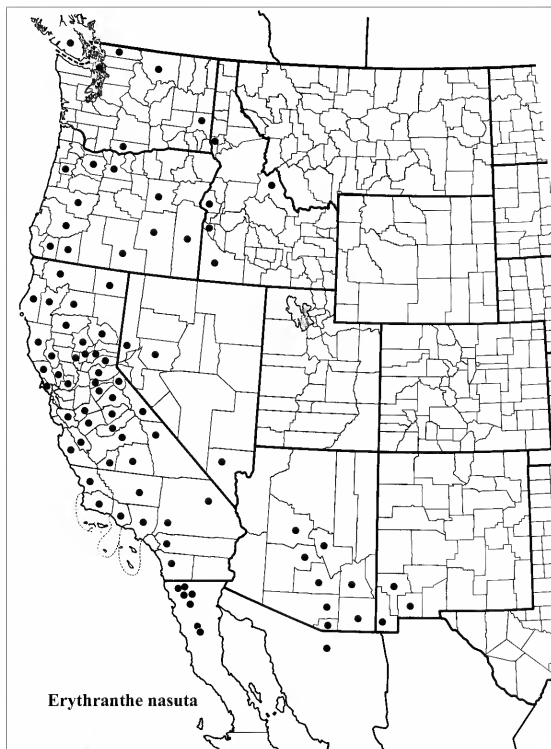
Map 18. Distribution of *Erythranthe laciniata*, *E. glaucescens*, and *E. nudata*.



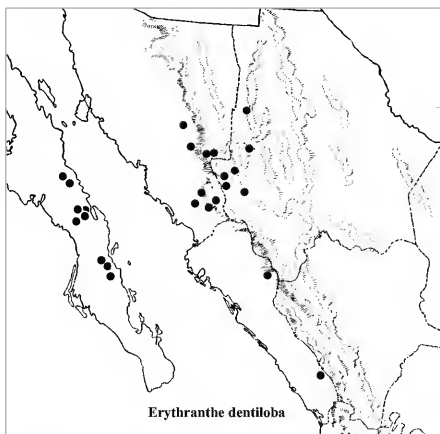
Map 19. Distribution of *Erythranthe pardalis*.



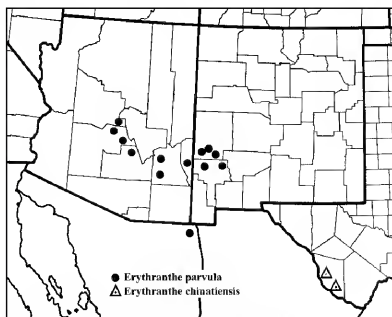
Map 20. Distribution of *Erythranthe marmorata*.



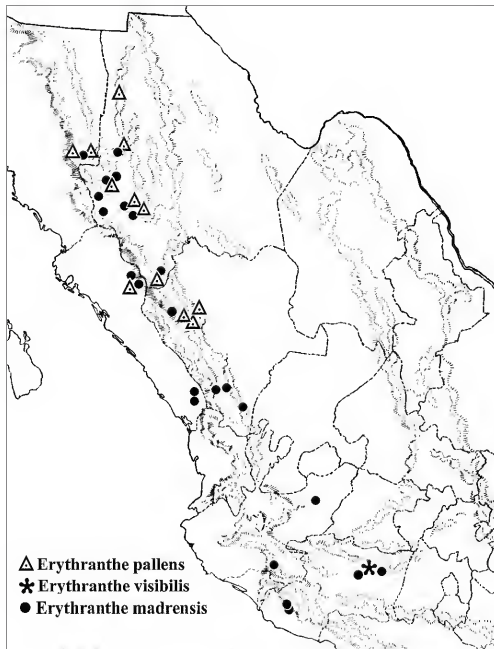
Map 21. Distribution of *Erythranthe nasuta*



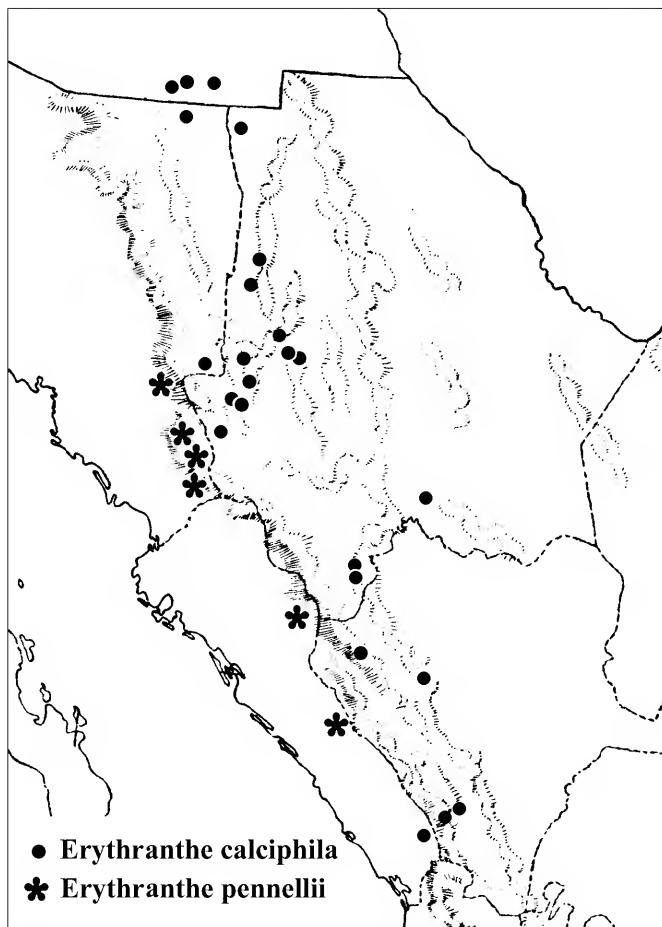
Map 22 Distribution of *Erythranthe dentiloba*



Map 23. Distribution of *Erythranthe parvula* and *E. chinatiensis*



Map 24 Distribution of *Erythranthe madrensis*, *E. pallens*, and *E. visibilis*.



Map 25. Distribution of *Erythranthe calciphila* and *E. pennellii*. In the USA, *E. calciphila* occurs in the Chiricahua, Dragoon, and Huachuca Mountains of Cochise Co., Arizona.

## TAXONOMY OF *ERYTHRANTHE* SECT. *MIMULOSMA* (PHRYMACEAE)

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### ABSTRACT

Seventeen species are treated as members of *Erythranthe* sect. *Mimulosma* in North America north of Mexico: *E. ampliata*, *E. arenaria*, ***Erythranthe austrolatidens*** Nesom, sp. nov. (Baja California Sur), *E. breviflora*, *E. floribunda*, *E. geniculata* (synonym: *Mimulus dudleyi*), *E. hymenophylla*, *E. inflatula* (synonym: *Mimulus evanescens*), *E. inodora*, *E. jungermannioides*, *E. latidens*, *E. moniliformis*, *E. moschata*, *E. norrisii*, *E. patula*, *E. pulsfrae*, and *E. washingtonensis*. The section also is hypothesized also to include one Russian species (*E. stolonifera*) for a total of 18 species. Descriptions, typifications, a key to species, and distribution maps are provided.

**KEY WORDS:** *Mimulus moschatus*, *Mimulus floribundus*, *Erythranthe* sect. *Mimulosma*, *Mimulus moschatus* alliance, Phrymaceae

Sect. *Mimulosma* of the genus *Erythranthe* (formerly part of *Mimulus*; Barker et al. 2012) includes 19 species as treated here, including the widespread *E. moschata* and *E. floribunda*, primarily centered in their native ranges to the western USA. The group has often been referred to as the "*Mimulus moschatus* alliance." Grant (1924) placed these species within her more broadly encompassing *Mimulus* sect. *Paradanthus*.

North American species added here since study of the group by Whittall (1999), Carlson (2002), and Whittall et al. (2006) are *Erythranthe moniliformis*, *E. inodora*, *E. arenaria*, and *E. plotocalyx*. *Mimulus evanescens* proves to have been earlier named as *M. inflatulus* and an earlier name for *Mimulus dudleyi* is *M. geniculatus*. The group also includes one species endemic to southeastern Russia.

The taxonomy of sect. *Mimulosma* (as "the *Mimulus moschatus* alliance") has been studied using pollen morphology (Argue 1980, 1986), vegetative and reproductive morphology (Carlson 2002), and molecular data (Whittall 1999; Whittall et al. 2006). Molecular data show the group to be distinct, but Carlson was unable to find any morphological synapomorphies for it and described it as a "morphologically cryptic clade." Within *Erythranthe*, species of the group are generally recognized by their herbaceous habit, yellow corollas, equal to subequal calyx lobes, and glandular vestiture. Carlson (2002) noted that "traits ... associated with most ingroup species include a tetraploid chromosome number ( $N = 16$ ), progressively bifurcated stem architecture, viscid herbage, anthers that open completely, and unequal theca."

Most resolutions of molecular and morphological phylogenies divide the species of *Erythranthe* sect. *Mimulosma* between two main groups — a northern group (the "Columbia River clade"; see Maps 1 and 2) and a more southern group (the "Sierra Nevada clade"). The latter includes *E. floribunda*, *E. geniculata*, *E. norrisii*, *E. arenaria*, *E. moschata*, *E. inodora*, and *E. moniliformis*. The Columbia River clade includes *E. ampliata*, *E. patula*, *E. hymenophylla*, *E. jungermannioides*, *E. washingtonensis*, and *E. breviflora*. *Erythranthe ampliata*, *E. patula*, and *E. hymenophylla* are a subgroup, the "Snake River clade," within the northern group. The positions of *E. latidens* and *E. pulsfrae* are equivocal; *E. plotocalyx*, first described here, appears to be similar to *E. latidens*.

*Erythranthe inflatula* is hypothesized to be of hybrid origin between *E. latidens* and *E. breviflora*. The Russian *E. stolonifera* apparently is most closely related to *E. moschata-moniliformis-modora*. Species not included in earlier studies are interpolated here on the basis of morphology and geography.

This account is based primarily on study of collections from ARIZ, BRIT-SMU-VDB, DAV, MO, ND-Greene, NMC, PH, SRSC, TEX-LL, UC-JEPS, and UT. Specimens are cited only for some of the species or variants that have not been generally recognized, but collections at herbaria above have been annotated in documentation of the concepts.

**ERYTHRANTHE** sect. **MIMULOSMA** Nesom & Fraga, Phytoneuron 2012-n: 0. 2012.

**TYPE:** *Erythranthe moschata* (Douglas ex Lindl.) Nesom

**Annuals** and fibrous-rooted or taprooted or **perennials** from rhizomes; vestiture of gland-tipped hairs, varying from minutely stipitate-glandular to villous-glandular, sometimes aromatic. **Leaves** pinnately or subpinnately to palmately veined. **Calyces** strongly ridge-angled to wing-angled at maturity, lobes mostly of equal or subequal length. **Corollas** yellow or white to pinkish or flesh-colored, strongly bilabiate to weakly bilabiate or nearly regular; palate puberulent to short-villous with stiff, usually clavate hairs. **Anthers** included. **Capsules** included (often slightly exserted in *E. norrisii*). Base chromosome number,  $x = 8$ .

Two pollen types were recognized by Argue (1980, 1986) among species of sect. *Mimulosma*. All pollen is tricolporate with multiple, elongate endoapertures. Those with the sexine 2 configuration predominantly microreticulate without supramural granules or spinules are type IIb: *Erythranthe arenaria*, *E. geniculata*, *E. floribunda*, and *E. moniliformis* (presumably *E. norrisii*, which was not sampled, also has type IIb). The others (including *E. moschata*), with supramural granules or spinules, are type IIc.

An autogamous mating system has evolved independently several times within *Erythranthe* sect. *Mimulosma*. Floral characters associated with a shift from allogamy to autogamy include decreased bilateral symmetry, less reflexed upper corolla lobes, and reduced overall corolla length (with corresponding reduction of anther/stigma separation). Carlson (2002) and Whittall et al. (2006) discussed the evolution of this syndrome and observed that it characterizes *E. floribunda*, *E. patula*, *E. breviflora*, *E. inflatula*, and *E. latidens* and it is noted here that similar features characterize *E. plotocalyx*.

### Key to the American species

#### 1. Plants from rhizomes and/or stolons.

2. Calyx lobes 1–2 mm, apices rounded to mucronate; anthers glabrous; styles scabrous; stolons forming overwintering turions; plants characteristically of cliff faces.

..... 1. *Erythranthe jungermannioides*

2. Calyx lobes 2–9 mm, apices acute or acuminate; anthers glabrous or pubescent; styles glabrous; stolons without turions; plants usually of habitats other than cliff faces.

3. Stems erect to ascending-erect; leaves often congested ..... 10. *Erythranthe moniliformis*

3. Stems procumbent to decumbent or decumbent-ascending; leaves distinctly separated.

4. Cauline leaves all petiolate, blades (10–)15–40(–50); fruiting pedicels (7–)10–25(–40) mm; calyx lobes triangular to linear-lanceolate or narrowly triangular-acuminate, 2–4 mm; corolla tube-throats 11–16 mm; anthers glabrous to subglabrous . 9. *Erythranthe moschata*
4. Cauline leaves usually sessile (proximal sometimes short-petiolate or subpetiolate), blades generally oblong-lanceolate, 30–70 mm; fruiting pedicels (15–)22–50 mm; calyx lobes linear-lanceolate to narrowly triangular with linear-acuminate apices, 5–9 mm; corolla tube-throats 15–18 mm; anthers strongly to weakly hirsute-hirtellous ..... 11. *Erythranthe inodora*

1. Plants fibrous-rooted or taprooted, without rhizomes or stolons.

5. Cauline leaves gradually petiolate to sessile or subsessile, blades generally elliptic to lanceolate-elliptic or ovate-elliptic with an attenuate base, palmately 3–5-veined.

6. Stems and pedicels villous-glandular with gland-tipped hairs 0.2–1(–1.5) mm.

7. Corolla tube-throats 9–12(–14) mm, red spots of lower lip conspicuous; calyx prominently red-dotted ..... 13. *Erythranthe arenaria*

7. Corolla tube-throats 5–6 mm, red spots of lower lip small and indistinct; calyx commonly without red dots

8. All leaves petiolate; erect to decumbent, sometimes procumbent-trailing, branching at proximal to distal nodes ..... 14. *Erythranthe floribunda* (in part, in Arizona)

8. Medial to distal cauline leaves sessile; stems erect to erect-ascending, mostly branched at the base ..... 15. *Erythranthe australatidens*

6. Stems and pedicels subglabrous to sessile-glandular or minutely stipitate-glandular with gland-tipped hairs 0.1–0.3 mm, without villous hairs.

9. Petioles 2–9 mm, distinctly 3-nerved (winged); fruiting pedicels 12–38 mm, divergent-arcuate ..... 12. *Erythranthe pulsiferae*

9. Petioles absent or 1–3 mm, 1-nerved; fruiting pedicels 5–28 mm, straight.

10. Fruiting calyces minutely stipitate-glandular, 8–12 mm; fruiting pedicels 11–28 mm; corolla tube-throats 5–6(–8) mm; leaves basal and cauline ..... 8. *Erythranthe latidens*

10. Fruiting calyces sparsely and minutely hirtellous, eglandular or sparsely sessile-glandular, 5–6 mm or 7–11 mm; fruiting pedicels 5–11 mm or 7–18 mm; leaves mostly cauline (basal deciduous by flowering).

11. Fruiting calyces 5–6 mm; fruiting pedicels 5–11 mm; corolla tube-throats 3.5–5 mm, not exerted beyond the calyx margin; all leaves short-petiolate

- ..... 6. *Erythranthe breviflora*

11. Fruiting calyces 7–11 mm; fruiting pedicels 7–18 mm; corolla tube-throats 5–6(–8) mm, exerted 1–3 mm beyond calyx margin; midcauline and distal leaves subpetiolate to subsessile..... 7. *Erythranthe inflatula*

5. Cauline leaves abruptly and distinctly petiolate, blades generally ovate with a rounded to truncate or cordate base; palmately or pinnately veined.

12. Stems prostrate to ascending-erect, sharply bent at the basal nodes; fruiting pedicels divergent at ca. right angles from the stem, often closely paired; calyx lobes ovate-rounded

- ..... 3. *Erythranthe hymenophylla*



12. Stems erect to prostrate, decumbent, or ascending, straight (if erect) or geniculate at nodes; fruiting pedicels suberect to ascending-erect, not paired; calyx lobes acute to deltate or shallowly deltate-subulate.

13. Stems and pedicels stipitate-glandular (gland-tipped trichomes unicellular, 0.05–0.2 mm long); leaf blades palmately veined.

14. Corollas regular to weakly bilabiate, tube-throats 7–8 mm 4. *Erythranthe patula*  
14. Corollas strongly bilabiate, tube-throats 8–12(–14) mm.

15. Stems, leaves, and calyces villous-glandular with vitreous, flattened, multicellular, gland-tipped hairs 0.1–0.8 mm long, leaves densely hairy; stems terete; styles hispid-hirtellous ..... 2. *Erythranthe washingtonensis*  
15. Stems, leaves, and calyces minutely sessile to subsessile glandular with gland-tipped hairs 0.05–0.2 mm long, leaves very sparsely glandular; styles glabrous; stems 4-angled ..... 5. *Erythranthe ampliata*

13. Stems and pedicels villous-glandular (gland-tipped trichomes multicellular, mostly 0.5–1.2(–2) mm long); leaf blades pinnately to subpinnately veined.

16. Plants mostly erect to ascending-erect; calyces greenish; styles hispid-hirtellous; Oregon and Washington ..... 2. *Erythranthe washingtonensis*  
16. Plants erect to prostrate, decumbent, or ascending; calyces commonly red-spotted; styles glabrous; widespread (15) or California (16, 17).

17. Corolla tube-throats (4–)5–10 mm, limbs expanded 3–4 mm across (pressed)  
..... 14. *Erythranthe floribunda*  
17. Corolla tube-throats 9–11 mm or 12–16 mm, limbs expanded 8–16 mm across (pressed).

18. Calyces with shallowly wing-angled ribs, lobes triangular-acute and erect to spreading or recurving-spreading in fruit; corollas without white patches, tube-throats 9–12 mm, expanded limb ca. 10–18 mm across  
..... 16. *Erythranthe geniculata*  
18. Calyces with rounded-thickened ribs, lobes linear-oblong and incurved in fruit; corollas with white patches on the lower lip, tube-throats 12–16 mm, expanded limb 15–30 mm across ..... 17. *Erythranthe norrisii*

1. *Erythranthe jungermannioides* (Suksdorf) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus jungermannioides* Suksdorf, Deutsche Bot. Monatsschr. 18: 154. 1900. TYPE: USA. Washington. Klickitat Co.: steep, overhanging, damp cliffs near Bingen, Aug-Nov 1892, W.N. Suksdorf 1470 (holotype: MO!; isotypes: F, NY digital image!, UC!, US digital image!, WTU).

**Perennial**, from thin, above-ground stolons or runners that form terminal bud-like structures (overwintering turions). **Stems** decumbent to procumbent, 5–38(–60) cm, simple or branching near the base. **Stems and pedicels** densely glandular-villous with gland-tipped hairs 0.5–1.2(–1.5) mm. **Leaves** cauline, basal not persistent, blades broadly ovate to broadly lanceolate, 7–35(–40) mm x 8–25 mm, subpalmately to pinnately veined, margins sharply and irregularly dentate to denticulate, apex acute to obtuse, base rounded; petioles mostly 2–5(–20) mm. **Fruiting calyces** cylindric-urceolate, 6–12 mm, plicate-angled, weakly inflated, glandular-villous, lobes subequal, 1–1.5 mm, rounded-

acuminate, suberect, ciliate. **Fruiting pedicels** 15–35 mm. **Corollas** yellow with scattered red spots and two white patches at the tips of the palate ridges, strongly bilabiate, tube-throats funnelliform, (12–)16–20(–24) mm, limbs expanded 8–10 mm (pressed), lobes obovate-oblong, apex rounded to truncate. **Styles** scabrous. **Anthers** glabrous. **Capsules** elliptic-lanceolate, 5–9 mm.  $2n = 32$ . Map 1.

Flowering May–Jul(–Aug). Basalt crevices in seepage zones in vertical cliff faces and canyon walls, within xeric sagebrush communities; 100–400(–1200) m; Oreg., Wash. The record on Map 1 for Jefferson Co., Oregon, is added from OBIC (2011). The Klickitat Co., Washington, occurrence is termed "historical" by WNHP (2005), which also notes that "A sighting of the plant on the WA side was made in the early 1990s, but the location and presence of the species need to be confirmed."

Molecular data place *Erythranthe jungermannioides* and *E. washingtonensis* as sister species.

2. *Erythranthe washingtonensis* (Gandoger) Nesom, Phytoneuron 2012-39: 39. 2012. *Mimulus washingtonensis* Gandoger, Bull. Soc. Bot. France 66: 218. 1919. **TYPE:** USA. Washington. Klickitat Co.: low sandy banks of the Columbia, Bingen, Oct–Nov 1885, *W.N. Suksdorf 560* (holotype: LY; isotypes: CAS digital image!, CU, DS digital image!, GH, MO 2 sheets!, ND-Greene!, NY 2 sheets digital images!, ORE digital image!, OS digital image!, PHI, UC 2 sheets!, US digital image!, WS, WTU).

Printed labels by Meinke in 1987 on type specimens give this: "ISOTYPE of *Mimulus washingtonensis* Gandoger, according to number only; ... The numerous sheets distributed under no 560 collectively represent a hybrid swarm of undetermined parentage, probably involving *M. washingtonensis*, *M. patulus*, and *M. floribundus*." Meinke did not provide document to substantiate his observation. Among the plants I have studied of the type collection, density of villous hairs near the stem bases and on the leaf blades varies, and one of the 16 individual plants on the two UC sheets has minutely hirtellous lower cauline vestiture, but all plants I have seen of the type collection have villous-glandular leaf surfaces, which distinguishes them from *E. ampliata*. Matt Carlson (pers. comm.) also notes that he finds the vestiture of the type collection uncharacteristic of the species in its wider occurrence, but whether this has resulted from hybridization is not evident.

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** erect to ascending, 5–25 cm, often many-branched, terete. **Stems and pedicels** puberulent-glandular to villous-glandular with gland-tipped hairs 0.1–0.8 mm, hairs sometimes vitreous, flattened, and distinctly multicellular. **Leaves** cauline, basal not persistent, blades deltate or ovate to ovate-lanceolate, 4–16(–23) mm  $\times$  2–11(–16) mm, palmately veined, margins denticulate to entire, apex acute, base rounded to cuneate or truncate, petioles 2–14 mm. **Fruiting calyces** tubular, 6–8 mm, ridge-angled, weakly inflated, densely and minutely stipitate-glandular, lobes subequal, 0.8–1.2 mm, shallowly deltate, suberect, ciliate. **Fruiting pedicels** 20–50 mm, divergent at nearly right angles. **Corollas** yellow with small reddish brown dots and two white patches on the lower lip, strongly bilabiate, tube-throats funnelliform, 8–10 mm, limbs spreading 7–10 mm (pressed), lobes obovate-oblong, apex rounded to rounded-cuneate. **Styles** hispid-hirtellous. **Anthers** glabrous. **Capsules** ellipsoid to ellipsoid-fusiform, 5–8.5 mm.  $2n = 32$ . Map 1.

Flowering May–Sep. Shallow basalt gravels in narrow channels and intermittent streams, sandy stream banks, open slopes, rocky shelves near seeps; 700–1300 m; Oreg., Wash.

Despite the implication of the epithet, except for the type collection *Erythranthe washingtonensis* occurs most abundantly in the John Day River drainage of eastern Oregon.

**3. *Erythranthe hymenophylla*** (Meinke) Nesom, *Phytoneuron* 2012-39: 38. 2012. *Mimulus hymenophyllus* Meinke, *Madroño* 30: 147, plate 1. 1983. TYPE: USA. Oregon. Wallowa Co.: E side of Horse Creek, ca. 12 km S of the Imnaha River and ca. 21 km W of the Snake River, 1075 m, 2 Jul 1980, R.J. Meinke & Kennison 2656 (holotype: OS digital image!; isotypes: ID, NY digital image!, ORE digital image!, UC!, US digital image!, WS, WTU).

**Annual**, filiform-taprooted. **Stems** prostrate to ascending-erect, 5–25 cm, simple or few-branched. **Stems and pedicels** glandular-puberulent to glandular-villous with vitreous, flattened, multicellular, gland-tipped hairs 0.1–0.8 mm, all hairs glandular. **Leaves** basal and cauline, largest at midstem, blades broadly lanceolate to ovate, 10–35 mm x 10–30 mm, pinnately veined, distinctly membranous, margins coarsely dentate to shallowly denticulate or entire, apex acute to obtuse, base cuneate to shallowly cordate, petioles 6–30 mm. **Fruiting calyces** tubular-campanulate, angled, 5–7 mm, slightly inflated, sparsely stipitate-glandular, lobes subequal, 0.5–1.2 mm, ovate-rounded, suberect, ciliate. **Fruiting pedicels** 10–45 mm, negatively phototropic, causing the capsules to be pressed against the cliff face or into a crevice by the time of dehiscence. **Corollas** light yellow with red or purple spots on the throat and lower lobes, sometimes with small white patches, weakly bilabiate, tube-throats funnellform, 10–14 mm, lobes obovate-oblong, apex rounded to truncate or notched. **Styles** glabrous. **Anthers** glabrous. **Capsules** ovoid, 3–6 mm.  $2n = 32$ . Map 1.

Flowering Apr–Aug(–Sep). Steep, seasonally moist basalt cliffs with W or SW exposure, within mesic coniferous forests; 800–1300 m; Idaho, Mont., Oreg.

Until recently, *Erythranthe hymenophylla* has been thought to be restricted to deep canyons of Horse Creek and Cow Creek in southeast Wallowa County, Oregon. The Oregon Biodiversity Information Center (2010) notes that the species also is known in Idaho and Montana — county records are added from BONAP (2011).

Meinke (1983) observed that plants of *E. hymenophylla* have reflexed ("strongly negatively phototropic") fruiting pedicels that increase seed dispersal back onto the vertical cliff wall, the characteristic habitat of the species. The "hanging" habit of *E. hymenophylla* is reflected in a sharp (90°–180°) bend in the basal nodes and the long pedicels that are closely paired and divergent in parallel at about right angles from the stem. The species also is characterized by it very short calyx to corolla length, relatively short capsules, and very large seeds.

**4. *Erythranthe patula*** (Pennell) Nesom, *Phytoneuron* 2012-39: 39. 2012. *Mimulus patulus* Pennell, *Proc. Acad. Natl. Sci. Philadelphia* 99: 162. 1947. TYPE: USA. Washington. Whitman Co.: Wawawai, along irrigation ditches, May 1897, A.D.E. Elmer 752 (holotype: PHI; isotypes: MO-2 sheets!, SMU!, US digital image!).

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** erect to ascending, (3–)5–15(–24) cm, usually simple. **Stems and pedicels** stipitate-glandular with gland-tipped hairs 0.2–0.5 mm. **Leaves** cauline, basal not persistent, blades deltate or ovate to ovate-lanceolate, 4–12(–17) mm x 3–10(–14) mm, palmately 3-veined, margins usually denticulate, apex acute to obtuse, base rounded to cuneate-truncate, petioles (5–)8–25 mm. **Fruiting calyces** tubular, 5–6(–7) mm, not inflated or weakly so, sparsely stipitate-glandular to sparsely hirtellous, lobes subequal, 0.7–1.1 mm, deltate, suberect, ciliate. **Fruiting pedicels** 10–25(–38) mm. **Corollas** yellow, usually with a few red or brownish dots on lower lip, regular to very weakly bilabiate, tube-throats funnellform, 7–8 mm, lobes oblong, apex rounded to truncate. **Styles** glabrous. **Anthers** glabrous. **Capsules** ellipsoid to narrowly obovoid, 4–6 mm.  $2n = 32$ . Map 1.

Flowering Apr–May(–Jul, –Aug). Ephemeral seeps, springs, rocky stream banks, moist basalt, fine gravel on top of bedrock, muddy hillside seeps, crevices; 200–1900 m (–2900 m in Montana and Wyoming); Alberta; Idaho, Mont., Oreg., Wash., Wyo.

*Erythranthe patula* is distinctive in its long-petiolate leaves with ovate blades and its small, weakly bilabiate to nearly regular corollas.

In his dissertation, Meinke (1992) proposed to recognize *Mimulus patulus* "var. *montanus*," characterized by a cauline vestiture of a mixture of stipitate-glandular hairs and minute (0.1–0.2 mm), sharp-pointed eglandular hairs and with a geographic distribution considerably beyond the typical expression in its range of two or three counties at the corner of eastern Oregon and Washington. The vestiture of typical *Mimulus patulus* is constituted only by minute, stipitate-glandular hairs. "Var. *montanus*" was not mentioned again in later publications of which Meinke was author or coauthor (Meinke 1995; Whittall et al. 2006) and the MO specimen cited as an isotype of "var. *montanus*" cannot be located at MO or UC.

In any case, intergrades between the two vestiture types appear to indicate that the vestiture is variable within a single species. Meinke (1992) noted that a collection from Wallowa Co., Oregon (Peck 18282, NY, WILLU) included plants of both var. *patulus* and var. *montanus*. A collection from Idaho Co., Idaho (Gray 5571, MO), might also be interpreted as a mixed collection in the same way. Plants of other collections in 2009 by Karen Gray (MO) from Nez Perce and Idaho counties, Idaho, have stipitate-glandular pedicels but hirtellous, eglandular stems. Collections from Teton Co., Wyoming, have stipitate-glandular stems and pedicels but hirtellous calyces (Payson & Payson 2226; Williams 875; Williams 992; all MO) and would strictly be identified as var. *patula*. Anderson 366 (UC) from Teton Co. has sparsely glandular calyces. Analogous variation in vestiture occurs among populations of *Erythranthe breviflora* as well as in *E. guttata* (Fischer ex DC.) Nesom of sect. *Simolus* (Nesom 2012).

5. *Erythranthe ampliata* (A.L. Grant) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus ampliatus* A. L. Grant, Ann. Missouri Bot. Gard. 11: 214. 1924. TYPE: USA. Idaho. Nez Perce Co.: about Lake Waha, 2000–3500 ft, 27 Jun 1896, A.A. and E.G. Heller 3330 (holotype: MO!; isotypes: JEPS, MO!, ND-Greene!, UC). The original labels were distributed with a handwritten identification of "*Mimulus longipedunculatus* Heller, n. sp.," but that name was never published.

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** erect to ascending, 5–17 cm, often many-branched, 4-angled. **Stems and pedicels** sessile- to subsessile-glandular with gland-tipped hairs 0.05–0.2 mm. **Leaves** cauline, basal not persistent, blades broadly ovate to lanceolate, 8–25 mm x 5–19 mm, palmately veined, margins dentate to coarsely denticulate, apex acute to obtuse, base cuneate, petioles 8–20 mm. **Fruiting calyces** tubular-campanulate, 6–8 mm, not inflated or weakly so, minutely sparsely stipitate-glandular to glabrous, lobes subequal, triangular-acute, suberect, ciliate. **Fruiting pedicels** 10–22 mm. **Corollas** deep yellow with a few brownish dots on the lower lip, sometimes with small white patches, strongly bilabiate, tube-throats broadly funnelform, 8–12(–14) mm, lobes obovate-oblong, apex rounded to truncate. **Styles** glabrous. **Anthers** glabrous. **Capsules** fusiform to narrowly ellipsoid, 5–6 mm. Chromosome number unknown. Map 1.

Flowering Jun–Jul. Basalt outcrops, seepy roadcuts, grassland seeps; 900–1700 m; Idaho (Nez Perce and Idaho counties).

Meinke referred to *Mimulus ampliatus* as a variety (1992) or subspecies (1995) of *M. washingtonensis*, but he apparently never made the formal combination. As understood here, *Erythranthe ampliata* and *E. washingtonensis* have disjunct geographic distributions and are non-intergrading in morphology (as in the key). The geography and vestiture of *E. ampliata* are more similar to *E. patula* than to *E. washingtonensis*.

6. *Erythranthe breviflora* (Piper) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus breviflorus* Piper, Bull. Torrey Bot. Club 28: 45. 1901. TYPE: USA. Washington. Whitman Co.: Pullman, 3 Jul 1894, C.V. Piper 1858 (holotype: WS; isotypes: OS digital image!, UC, US digital image!).

**Annuals**, shallowly fibrous-rooted. **Stems** ascending, 4–15 cm, branched at lower and middle nodes. **Stems and pedicels** (and leaves) minutely stipitate-glandular with gland-tipped hairs 0.1–0.3 mm, without villous hairs, sometimes minutely hirtellous with minute-sharp-pointed eglandular hairs (as in *E. patula*). **Leaves** mostly cauline (basal mostly deciduous by flowering), blades narrowly ovate or narrowly lanceolate to elliptic or elliptic-lanceolate, largest mostly 5–15 mm x 2–6 mm, relatively even-sized, or slightly reduced distally, palmately 3-veined, margins entire to mucronulate or denticulate, apex acute to obtuse, base attenuate, narrowed to short (1–3 mm) petiolar regions or subpetiolar to subsessile. **Fruiting calyces** campanulate becoming ovoid-ellipsoid to campanulate, 5–6 mm x 3.5–6 mm, winged and plicate-angled, distinctly inflated, sparsely and minutely hirtellous, eglandular or sometimes sparsely sessile-glandular, lobes subequal, 0.5–1 mm, ovate-deltate, suberect, ciliate. **Fruiting pedicels** 5–11 mm, straight. **Corollas** yellow, spotted or striped, tube-throats cylindric to narrowly funnelform, 3.5–5 mm, not exerted beyond the calyx rim, limb weakly bilabiate, barely widened, lobes broadly obovate, apex rounded. **Styles** glabrous. **Anthers** glabrous. **Capsules** oblong-ovoid to ovoid-cylindric, 4–6 mm. Chromosome number unknown. Map 2.

Flowering May–Jul. Stream and lake sides, gravel bars, springs, moist slopes, damp swales between dunes, along trails; 1000–2300 m; British Columbia; Calif., Idaho, Mont., Nev., Oreg., Wash.

Voucher specimens for range extremities. **British Columbia**. 21.5 mi by road on Rossland-Cascade road from junction near Rossland, occasional on rocky, grassy, S-facing slopes, 4250 ft, 5 Aug 1953, *Calder and Saville 11483* (UC). **Nevada**. Humboldt Co.: Santa Rosa Mts., Martin Creek, moist seep under Veratrum, 7500 ft, 25 Jul 1940, *Munz 16152* (UC).

7. *Erythranthe inflatula* (Suksdorf) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus inflatulus* Suksdorf, Werdenda 1: 38. 1927. TYPE: USA. Washington. Klickitat Co.: In cultivation at Bingen, "25 May 1901–10 Jun 1903," *W. Suksdorf 9916* (possible holotype: WS; duplicates: MO!, UC!). MO and UC sheets were annotated as 'isolectotype' by R.J. Meinke in 1987.

The type sheet of *Mimulus inflatulus* at MO was identified by annotation by R.J. Meinke in 1987 as *Mimulus breviflorus* subsp. *robustus* Meinke (an unpublished name). He annotated a collection from Harney Co., Oregon (*M.E. Peck 21389*, NY digital image!) as "isotype" of *Mimulus brevifolius* var. *robustus*. Neither *M. inflatulus* nor the name "subsp. *robustus*" was mentioned in subsequent publications by Meinke (1995a, 1995b, 2007).

*Mimulus evanescens* Meinke, Great Basin Naturalist 55: 250, plate 1. 1995. TYPE: USA. **California**. Lassen Co.: 20.5 km E of Adin, N side of Ash Valley Rd., ca 0.1 km E of the Lassen National Forest boundary, in broken boulders and heavy gravel abutting Moll Reservoir, ca 1500 m, 27 Jun 1990, *R.J. Meinke & T. Kaye 5900* (holotype: OS; isotypes: MO, NY, RM, UC, US, UTC). Deposition of types is as cited by Meinke but judging from their absence on online databases associated with those herbaria, it would seem that none of the specimens have been distributed. Close study of North American *Mimulus* sensu lato at MO and UC did not bring a duplicate of 5900 to light. A topotype has been studied (*Schoenig 98-70*), as cited below).

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** erect to ascending, 6–20(–25) cm, simple or branched at lower and middle nodes. **Stems and pedicels** (and leaves) minutely stipitate-glandular with gland-tipped hairs 0.1–0.3 mm, without villous hairs. **Leaves** mostly cauline (basal mostly deciduous by flowering), blades narrowly ovate or narrowly lanceolate to elliptic or elliptic-

lanceolate, largest 8–18(–30) mm x (1–)3–7 mm, relatively even-sized, or slightly reduced distally, palmately 3–5-veined, margins entire to mucronulate or denticulate, apex acute to obtuse, base attenuate to obtuse or rounded, narrowed to short (1–3 mm) petiolar regions on proximal, mostly subpetiolate to subsessile distally. **Fruiting calyces** campanulate, maturing ovoid-ellipsoid to campanulate or broadly urceolate, 7–11 mm x 5–6 mm, winged and plicate-angled, distinctly inflated, sparsely and minutely hirtellous, eglandular, lobes subequal, 0.5–1.5 mm, ovate-deltate to broadly triangular, suberect, ciliate. **Fruiting pedicels** 7–18 mm, straight. **Corollas** yellow to pale yellow, sparsely red-spotted or not, tube-throats cylindric, 5–8 mm, exerted 1–2 mm beyond the calyx apex, limb weakly bilabiate, barely widened, lobes broadly obovate, apex rounded or mucronate. **Styles** glabrous. **Anthers** glabrous. **Capsules** oblong-ovoid to ovoid-cylindric or broadly ellipsoid, 5–9 mm. Chromosome number unknown. Map 2. A fuller description is available in Meinke (1995a).

Flowering Jun–Jul. Drying edges, banks, and beds of summer-dry watercourses, near drying edges of small lakes or impoundments, often among rocks and shoreline detritus, occasionally in moist protected areas beneath low shrubs (generally *Artemisia tridentata*), apparently restricted to the ecotone between the upslope edge of the sagebrush-juniper dominated shrub zone and the semi-aquatic graminoids near the water's edge (Meinke 1995a, b); 1200–1700 m. Calif., Idaho, Nev., Oreg. The type collection from Klickitat Co., Washington, was from a cultivated plant — no natural occurrences are known from Washington.

Morphological and molecular data (Meinke 1995a; Beardsley et al. 2004) indicate that *Erythranthe inflatula* originated as a hybrid between *E. breviflora* and *E. latidens*. If so, its geography and biology suggest that it is reproductively stable. The putative parents are geographically and ecologically separated for the most part and the range of *E. inflatula* is considerably broader than the relatively small region where the parents are sympatric. In this region, however, *E. inflatula* may be difficult to distinguish from one or both of its putative parents.

Collections of *Erythranthe inflatula* are these, as cited by Meinke (2007) and with additions from the present study. **California.** Lassen Co.: 7.0 mi N of Madeline, ca. 1 mi N of Sage Hen siding on Southern Pacific RR, ca. 5500 ft, 28 Jun 1957, *Bacigalupi* 5989 (JEPS); 3.1 mi S of Madeline, ditches along US Hwy 395, on Madeline Plains, rich, black, peaty soil, 5300 ft, 28 Jun 1957, *Bacigalupi* 5998 (JEPS); 10 miles S of Ravendale, 9 Jun 1940, *Pennell* 25763 (P); 4.8 miles S of Madeline, 17 Jun 1958, *Raven & Solbrig* 13298 (JEPS). **Modoc Co.:** along Willow Creek, Jun 1894, *Austin s.n.* (UC); SW shore of Moll Reservoir, 2 meters from water's edge, 4920 ft, 5 Jul 1998, *Schoenig* 98-70 (DAV, JEPS); Damons Butte, ca. 2.6 mi W of Hwy 139, 4400 ft, cinder cone in a recent lava flow, in *Pinus jeffreyi* woodland with *Artemisia tridentata* understory, site recently burned, dominated by *Ceanothus velutinus*, 4 Jun 1988, *Taylor* 9745 (UC). **Shasta Co.:** ca. 1 mi W of Warner Grade Reservoir, on margins of N-most of four small seasonally inundated ponds, 3030 ft, 14 Jun 1991, *Taylor* 11886 (UC). **Siskiyou Co.:** 0.8 mi E of Tennant Rd, NE of Weed, E of Grass Lake and W of Bray on Old State Hwy, ca. 1000 plants in scattered groups on a vernal wet, meadowy flat of low scrub, *Oswald & Ahart* 9359 (UC). **Idaho.** Owhyee Co.: meadow, 3 mi S of Riddle, 1 Jul 1949, *Holmgren & Holmgren* 7973 (CAS, UC, WS, WTU). **Nevada.** Washoe Co.: near CA-NV state line in S end of Coppersmith Hills, clay-loam vernal area with silver sage, *Plagiobothrys*, tansyleaf suncup, 6100 ft, 23 Jun 1986, *Schoolcraft* 1635 (UC). **Oregon.** Crook Co.: Grizzly Butte, 18 Jun 1894, *Leiberg* 275 (NY, ORE, US). **Gilliam Co.:** forks of Cottonwood Canyon, 6 Jun 1894, *Leiberg* 156 (NY, ORE, P, US). **Grant Co.:** Ochoco National Forest, Graylock Butte, 6 Jul 1912, *Ingram s.n.* (RM). **Harney Co.:** dry watercourse near Frenchglen, 26 Jun 1942, *Peck* 21389 (CAS, NY, P, UC, WILLU) — probably on Burns BLM. **Klamath Co.:** along the E banks of Dog Hollow Reservoir, 12 Jun 2003, *Meinke s.n.* (OSC); shallow, stony drainage at SE edge of Campbell Reservoir, near culvert, *Meinke s.n.* (OSC) (both sites on Lakeview BLM). **Lake Co.:** along Dog Creek, W of Drews Reservoir, T. 40. S., R. 17. E., Sec. 11 (NE ¼), 3 Jul 1999, *Meinke s.n.* (donated to Lakeview BLM herbarium; OSC); Sagehen Creek bed, just N of Road 4017 (west of Drews

Reservoir, T. 40. S., R. 17. E., Sec. 1 (SE  $\frac{1}{4}$ ), 4 Jul 1999, *Meinke s.n.* (donated to Lakeview BLM herbarium; OSC); Whiskey Creek bed, above and below Road 4017 (just W of Drews Reservoir dam and picnic area), T. 40. S., R. 18. E., Sec. 8 (NE  $\frac{1}{4}$ ), 4 Jul 1999, *Meinke s.n.* (donated to Lakeview BLM herbarium; OSC); along Wool Lake drainage, SE margin of lake, along drying edges and banks of seasonal stream (mixed population with *M. latidens*), T. 38. S., R. 25. E., Sec. 12 (NW  $\frac{1}{4}$ ), 26 Jun 1999, *Meinke s.n.* (donated to Lakeview BLM herbarium; OSC). Wasco Co.: Near Dalles City, 18 Jun 1901, *Suksdorf 1029* (MO). Washington. The collection mapped from Klickitat Co. is the type.

Meinke (2007) knew *Erythranthe inflatula* as represented by only five extant populations or population complexes — in Lassen Co., California, and Klamath and Lake cos., Oregon, but recent collections have substantiated its existence elsewhere and older localities should be revisited toward the possibility that the species persists there. The account of RTE species of Oregon (Oregon Biodiversity Information Center 2010) lists Malheur County in the distribution of the species. Oswald (1992) cited additional collections from Lassen Co., California: pool along base of RR, paralleling Poison Lake adjacent to Pittville Rd, *Oswald 5652, 9263* (CHSC).

**8. *Erythranthe latidens*** (A. Gray) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus latidens* (A. Gray) Greene, Man. Bot. San Francisco Bay, 278. 1894. *Mimulus inconspicuus* var. *latidens* A. Gray, Synopt. Fl. N. Amer. (ed. 2) (1, Suppl.): 450. 1886. **LECTOTYPE:** (cited by Grant 1924, p. 202, as "TYPE"): USA. California. [Contra Costa Co.] Near Monte Diablo, 26 May 1862, *W.H. Brewer 1161* (GH?; isotypes: UC!, US digital image!). The protologue gives "On the flanks of Monte Diablo, *Brewer, Greene, and Chollas Valley, San Diego Co., Orcutt.*" The UC sheet is annotated as "Isotype!" by Grant.

Grant (1924) indicated that she saw the Brewer collection at GH but it is not listed on the Harvard University Herbaria website. The specimen currently listed on the website as the type of *Mimulus inconspicuus* var. *latidens* is this: California. San Diego Co.: Chollas Valley, San Diego, 20 Jun 1884, *C.R. Orcutt 679* (GH, MO!). An apparent duplicate of the Orcutt collection is at PH, although it has only incomplete collection data. On the Brewer 1161 sheet at UC sheet, Pennell made the following annotation in 1941: "As type of *M. inconspicuus latidens* Gray I take C.R. Orcutt's 479, collected June 20, 1884 at Chollas Valley, San Diego, Calif., since it supplied Gray with most ample material and was his only collection accompanied by dissected flowers in a packet, thus showing its special study by him."

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** ascending to ascending-erect, 3–10(–25) cm, usually multiply branched from the base. **Stems and pedicels** (and leaves) short-stipitate-glandular to sessile-glandular with gland-tipped hairs 0.1–0.3 mm, without villous hairs. **Leaves** basal and cauline, largest at base or near midstem, sometimes unreduced in size up to the uppermost nodes, cauline blades ovate to ovate-lanceolate, 8–26(–35) mm, palmately 3(–5)-veined, margins entire or barely mucronulate to shallowly dentate-mucronulate, 1–3 teeth or mucronulae per side, apex acute to rounded, base abruptly cuneate to rounded, sometimes subauriculate, petioles absent. **Flowers** (1–)3–12. **Fruiting calyces** tubular-campanulate, ovoid-ellipsoid, prominently 5-angled, purplish, 8–12 mm x 4–7 mm, strongly inflated, mostly minutely stipitate-glandular, lobes subequal, triangular-acute, suberect, ciliate. **Fruiting pedicels** 11–28 mm. **Corollas** white to pinkish or flesh-colored, rarely yellowish, red-spotted on throat and lower lobes, tube-throats cylindric, 5–6(–8) mm, exerted 1–2 mm beyond calyx margin, limbs nearly actinomorphic, barely widened, lobes broadly obovate, rounded. **Styles** glabrous. **Anthers** glabrous. **Capsules** oblong to oblong-obovoid, 6–7 mm. Chromosome number unknown. Map 2.

Flowering Apr–Jun. Drained flats or slopes subject to vernal inundation, depressions in open fields, bare clay soil, vacant lots, roadsides; 10–800 m; Calif., Oreg.; Mexico (Baja California).

A collection of *Erythranthe latidens* from Madera Co., California, has fruiting calyces 8–12 mm long and variably inflated. The distinction between *E. latidens* and *E. inflatula* sometimes seems arbitrary in northwestern California, where they are sympatric.

9. *Erythranthe moschata* (Douglas ex Lindley) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus moschatus* Douglas ex Lindley, Bot. Reg. 13: plate 1118. 1828 [1827?]. *Mimulus guttatus* var. *moschatus* (Douglas ex Lindley) Prov., Fl. Canada 1: 439. 1862. TYPE: USA. Oregon. [Multnomah Co.]: Garden specimens grown from seeds collected 'in moist rocks on the Multnomah and the Columbia at the falls of both, 23 May 1825, D. Douglas s.n. (holotype: BM?). A specimen at BM (Canada, 1826, D. Douglas s.n., BM digital image!) may prove to be the type but the collection data, as given by BM, do not appear to match the protologue. Lindley wrote that Douglas found it "growing sparingly on the margins of springs in the country about the river Columbia, in North-West America."

*Mimulus crinitus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 186. 1924. *Mimulus acutidens* Reiche, Fl. Chile 6: 63. 1911 (not *M. acutidens* Greene 1885). TYPE: CHILE. Prov. Valdivia, en pantanos, O. Buchtner 159 (holotype: SGO).

*Mimulus leibergii* A.L. Grant, Ann. Missouri Bot. Gard. 11: 231, pl. 6, f. 1. 1924. TYPE: USA. California. [Plumas Co.]: Mt. Pleasant, Spanish Peak Range, wet soil along creek, 6500 ft, 16 Jul 1900, J.B. Leiberg 5171 (holotype: US digital image! photo-MO! photo-UC!).

**Perennials**, rhizomatous, rooting at lower nodes. Stems ascending to decumbent or prostrate, 2–30(–40) cm, simple or branched. Stems and pedicels glandular-villous with gland-tipped hairs 1–2 mm. Leaves cauline, basal not persistent, blades oblong-ovate, (10–)15–40(–50) mm x 5–25 mm, pinnately veined, margins coarsely serrate-dentate to denticulate or subentire, apex acute, base truncate to rounded or subcordate, petioles (1–)2–5(–10) mm. **Fruiting calyces** campanulate, 6–13 mm, weakly inflated or not at all, villous to glandular-villous, plicate-angled, lobes lobes strongly unequal to subequal, 2–4 mm, triangular to linear-lanceolate or narrowly triangular-acuminate, erect to spreading-recurving, ciliate. **Fruiting pedicels** (7–)10–25(–40) mm. **Corollas** mostly yellow with red to blackish or brown lines or red dots or both in the throat on the lobes, weakly bilabiate to nearly regular, tube-throats narrowly funnelliform, 11–16 mm, lobes oblong-obovate, apex usually notched. **Styles** glabrous. **Anthers** glabrous to very slightly hirtellous or scabrous. **Capsules** ovoid, 3–7(10?) mm.  $2n = 32$ . Map 4.

Flowering May–Aug. Shaded and wet places in sagebrush, aspen, spruce-fir, lodgepole pine, and meadows; 1200–3100 m; B.C., Alta., N.B., Nfld., N.S., Ont., Que., P.E.I.; S.P.M.: [western USA] Calif., Colo., Idaho, Mont., Nev., Oreg., Utah, Wash., Wyo., [eastern USA] Conn., Maine, Mass., Minn., N.H., N.J., N.Y., Penn., R.I., Vt., Va., W.Va., Wis.; introduced: South America (Chile), Europe, Australia, New Zealand, Asia (Japan).

Pennell (1935) noted that the Chilean *Mimulus acutidens* Reiche is the same species as the North American *M. moschatus* and indeed plants from Peru and Chile appear to be inseparable from *M. moschatus* in habit, vestiture, and calyx morphology. Pennell's assessment is corroborated in the present study, based on study of numerous South American collections at MO and UT. Fruiting calyces of the Chilean plants are 6–8 mm, barely expanded from flower; corolla tube-throats 10–12 mm. Von Bohlen (1995b) maintained *Mimulus crinitus* as a distinct species (including *M. acutidens* Reiche as a synonym) but noted that a closer analysis of North American material of *M. moschatus* would be necessary for a better judgement. *Mimulus acutidens* and *M. moschatus* sensu stricto are conspecific.

*Erythranthe moschata* as treated here, recognizing the segregates *E. moniliformis* and *E. inodora*, is narrower in concept than those of recent decades (e.g., Thompson 1993; Carlson 2002; Whittall et al. 2006), where only the single broad species was recognized. Whittall et al. (2006) noted



that "the *Mimulus moschatus* alliance is a group of 13 closely related species with uncertain species boundaries and interspecific relationships (Grant 1924; Pennell 1951; Argue 1986; Meinke 1992; Whittall 1999; Carlson 2002)," but this seems unfair particularly to Pennell, who recognized the two segregates of *M. moschatus* (he also recognized *M. macranthus* as distinct, but it is here regarded as conspecific with *M. moniliformis*). Studies of pollen morphology (Argue 1980, 1986) also explicitly support the segregation of *M. moniliformis* (which has unornamented muri) from *M. moschatus*. Argue's tentative distinction (1980) of the pollen of *M. inodorus* from that of *M. moschatus* was not confirmed in the 1986 study.

In contrast, it seems that neither Meinke nor Whittall nor Carlson has even mentioned the potential existence of the segregates. Munz and Keck (1959) recognized *Mimulus moschatus* var. *moniliformis* as distinct but treated *M. inodorus* as a synonym of *M. moschatus* var. *moschatus*. The only synonym included by Thompson (1993) as a synonym of the broadly conceived *M. moschatus* was "*M. moschatus* var. *moniliformis*."

Each of the three species recognized here (*Erythranthe moschata*, *E. moniliformis*, *E. inodora*, using criteria similar to those of Pennell) has a distinct range but each overlaps with the other two (Maps 3 and 4), and while there are indications that hybrids may be formed, all three apparently maintain their morphological distinction. Zones of intergradation in the areas of overlap are not evident but field studies are needed to examine this more closely.

10. *Erythranthe moniliformis* (Greene) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus moniliformis* Greene, Bull. Calif. Acad. Sci. 1: 10. 1884. *Mimulus moschatus* var. *moniliformis* (Greene) Munz, Aliso 4: 99. 1958. TYPE: USA. California. [Kern Co.]: Summit Station, Aug 1883, *E.L. Greene s.n.* (holotype: CAS?; isotypes: GH, MO!). Not located at ND-Greene. Protologue: "Common in dry rocky places of the Sierra, from 4,000 to 8,000 ft. In the collections of Bolander, Kellogg and others, this species occurs abundantly, and is named '*M. moschatus*,' being confounded with the last species."
- Mimulus dentatus* var. *gracilis* A. Gray, Bot. Gaz. 7: 112. 1882. TYPE: USA. California. [Shasta Co.]: Lassen's Peak, 1882, *Mrs. R.M. Austin s.n.* (holotype: GH). Not located at ND-Greene.
- Mimulus moschatus* var. *sessilifolius* A. Gray, Synopt. Fl. N. Amer. (ed. 2) 2(1): 447. 1886. Gray noted as a synonym "*M. inodorus* Greene, l.c., but the plant as strongly musk-scented as the ordinary species, at least in some cases." Gray also noted "Not rare in wet places, from San Bernardino Co., California, northward, and passing into the ordinary form in Oregon." SYNTYPES: USA. California: Butte Co.: Chico, Apr 1885, *A. Gray s.n.* (GH). California. Alameda Co.: Temescal, Tule swamps, Jun 1885, *W.S. Lyon* 6 (GH).
- Mimulus moschatus* var. *longiflorus* A. Gray, Synopt. Fl. N. Amer. (ed. 2) 2(1): 278. 1886. Gray noted only "The usual form in California, also in Oregon." In a later citation (p. 447), he noted "*M. moniliformis*, in part (the villous- and more or less viscous-pubescent plant), Greene, Bull. Calif. Acad. i. 119. Common especially in the Sierra Nevada." SYNTYPES: USA. California. Mariposa Co.: Yosemite Valley, 1886, *H.N. Bolander* 6306 and 6307 (GH).
- Mimulus macranthus* Pennell, Proc. Acad. Philad. 99: 160. 1947 TYPE: USA. California. Shasta Co.: Hatchet Mountain, 6 to 8 mi W of Burney, along stream in coniferous (*Pseudotsuga*) forest, 3900 ft, 7 Jun 1940, *F.W. Pennell* 25710 (holotype: PH!).

**Perennials**, rhizomatous. **Stems** erect to ascending, 10–30 cm, simple or usually branched. **Stems and pedicels** (and leaves) densely villous with glandular or weakly gland-tipped hairs 0.5–2 mm, very rarely glabrate. **Leaves** mostly cauline, basal not persistent, blades oblong-ovate to ovate, 18–40 mm x 7–13 mm, pinnately veined, margins dentate to denticulate, apex acute to obtuse, base rounded to subcordate, subclasping to sessile, petioles absent or 0.5–1 mm. **Fruiting calyces**

cylindric-campanulate, 10–11(–13) mm, weakly inflated, ridged-angled to winged-angled, villous-glandular, lobes subequal, 2–3 mm, lanceolate to triangular-subulate, spreading-recurving, ciliate. **Fruiting pedicels** 10–40 mm. **Corollas** yellow with fine blackish or brownish lines on all sides of the throat, red to brown spots present or not, tube-throats cylindric-funneliform, 12–18 mm, limbs weakly bilabiate to nearly regular, apex rounded. **Styles** glabrous. **Anthers** glabrous, rarely hirtellous. **Capsules** narrowly elliptic-ovoid, 6–8 mm. **Chromosome number** unknown. **Map** 4.

Flowering Jun–Aug. Around springs and seeps, creek edges, moist meadows, ditches, along trails, roadsides, rocky ridges, granite outcrops, serpentine talus, fir and pine forests; (1000–)1500–2800 ft; Calif., Oreg.

In his description of *Mimulus macranthus*, Pennell (1947, p. 160–161) noted that "This comprises the major part of the material that has been called *Mimulus moschatus longiflorus* Gray (not *M. longiflorus* (Nutt.) Grant), the remainder being mostly *M. inodorus* Greene. These plants, especially developed in the Cascade Range, and including *M. moniliformis* Greene, have been usually treated as forms of the Musk Flower, *M. moschatus* Dougl., but they seem better considered as distinct species ... ." He recognized both *M. macranthus* and *M. moniliformis*, distinguishing the latter by its "finely pubescent to glabrous leaves" and petiolate leaves. The vestiture proves to be more variable than allowed in Pennell's concept, thus Greene's older epithet has priority for this Sierra Nevada-centered species.

*Mimulus moniliformis* was described by Greene as "Near *M. moschatus*, wholly scentless, villous but scarcely viscid, 3–8 inches high from a perennial root, with subterranean shoots bearing moniliform strings of small tubers." Production of odor has been noted by various collectors and authors to vary in *Erythranthe moschata* and slender "moniliform" rhizomes also are variably produced within the species — neither feature separates *E. moniliformis* from *E. moschata*.

*Erythranthe moniliformis* is distinct from *E. moschata* in its erect habit (vs. decumbent to procumbent in *E. moschata*) and characteristically sessile to subsessile cauline leaves (vs. usually petiolate in *E. moschata*), lending an easily recognizable aspect to the plants. Pedicels of *E. moniliformis* are ascending-erect, while in *E. inodora* and *E. moschata*, both of which are essentially prostrate, pedicels are characteristically spreading at about 90 degrees. Leaves of *E. moniliformis* sometimes are short-petiolate and the distinctions in vestiture and corolla size noted by Pennell (1947) are not consistent. In spite of what may appear to be subtle differences, the two are distinct in geography.

**11. *Erythranthe inodora*** (Greene) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus inodorus* Greene, Bull. Calif. Acad. Sci. 1: 119. 1885. Greene did not cite a type; he referred to "*M. moschatus*, Gray, Bot. Cal. I. 569, not of Dougl. *M. moschatus*, var. *longiflorus*, Gray, Syn. Fl. 278" and noted "Common in both the Coast Range and the Sierra Nevada, throughout California, and also in Oregon." In the Synoptical Flora, Gray noted only "The usual form in California, also in Oregon."

Grant (1924) recognized this entity as *Mimulus moschatus* var. *sessilifolius* A. Gray (with *M. inodorus* as a synonym), here placed as a synonym of *Erythranthe moniliformis*, and noted that it occurs from British Columbia to southern California. She cited numerous specimens but not a type. Pennell (1951) treated it at specific rank, describing its range in California as only in northern counties.

*Mimulus moschatus* var. *pallidiflorus* Suksdorf, Deutsche Bot. Monatsschr. 18: 154. 1900. **TYPE:** USA. Washington. Skamania Co.: Springs near Chenoweth, 7 Jul 1894, W.N. Suksdorf 2320 (holotype: ?; isotypes: ORE digital image!, UC, US digital image!).

**Perennials**, rhizomatous, sometimes rooting at lower nodes. Stems usually prostrate, sometimes decumbent to ascending, 20–80 cm, few-branched. **Stems and pedicels** (and leaves) villous with eglandular hairs 1–2 mm, sometimes mixed with much shorter stipitate-glandular hairs. **Leaves** cauline, basal not persistent, blades oblong-lanceolate, 30–70 mm x 10–22 mm, pinnately veined, margins denticulate to dentate, apex acute, base rounded, petioles absent or uncommonly with petioles 1–2(–3) mm. **Fruiting calyces** cylindric-campanulate, 10–12 mm, weakly inflated, wing-angled or plicate-angled, glandular-villous with gland-tipped hairs, lobes strongly unequal, 5–9 mm, linear-lanceolate to narrowly triangular with long-acuminate-apiculate apices, spreading, ciliate. **Fruiting pedicels** (15–)22–50 mm. **Corollas** yellow with fine blackish or brownish lines on all sides of the throat, tube-throats narrowly campanulate, 15–18 mm, limbs weakly bilabiate and often nearly regular, apex rounded. **Styles** glabrous. **Anthers** consistently finely hirtellous to hispidulous. **Capsules** 6–8 mm. Chromosome number unknown. Map 5.

Flowering Jun–Sep. Creek banks, gravel bars, flood plains, shallow ditches, swales, damp banks, moist soil in coniferous woods, marshes, bogs, wet sand; 0–1900 m; British Columbia; Calif., Oreg., Wash.

Greene (1885) characterized the species as "Quite distinct from the true musk plant, being of more than twice the size, scentless, and possibly only annual; certainly never rooting at the joints," further noting "villous and slimy but wholly scentless; stems 1–3 feet long, weak and decumbent, but not creeping or rooting; leaves ... closely sessile by a broad base." In contrast to Greene's observation, several collections examined in the present study show that it indeed may root adventitiously at lower nodes.

*Erythranthe inodora* is recognized by its prostrate to decumbent or decumbent-ascending habit, large, mostly sessile leaves, dense villous vestiture, long pedicels, large calyces and corollas, hispid-hirtellous anthers, and particularly by its very long, strongly unequal, linear-triangular calyx lobes. The leaves typically and characteristically are sessile with truncate to rounded or subcordate bases but some are short-petiolate (e.g.: **California**: Lake Co., Heller 5923; Siskiyou Co., Heller 7960 and Oettinger 478. **Oregon**: Gilliam Co., Jones 28831; Jackson Co., Hammond 312. **Washington**: Skamania Co., the type of *Mimulus moschatatus* var. *pallidiflorus*). In these cases, the distinctive leaf bases, vestiture, calyx morphology, and pubescent anthers are generally diagnostic.

A population system of *Erythranthe inodora*-like plants from counties in southern California probably was the basis for Pennell's attribution (1951) of the species to that area, apparently about 300 miles disjunct from the main range of the species. These plants have the prostrate habit, large leaves, long pedicels, and large corollas of *E. inodora* but the calyx lobes are variable in length and usually do not show the attenuate-apiculate apices characteristic of the latter. Representative specimens: **California**. Los Angeles Co.: Verdugo Canyon, damp woods, 11 Aug 1910, Blake 1639 (LL); Oak Knoll, Aug 1902, Braunton 656 (UC). San Bernardino Co.: San Bernardino Mts.: marsh, 4000 ft, 21 Jul 1897, Chandler s.n. (UC); Lower South Fork Meadow, San Geronimo Wilderness Area, grassy montane meadow in mixed conifer forest, mostly *Pinus jeffreyi* and *Abies concolor*, ca. 7600–8000 ft, 15 Aug 1976, Davidson 4713 (UC); 1.2 mi E of Running Springs (town) on Calif. 18, common along seepage in road cut, sandy soil, 6100 ft, 19 Jun 1969, Holmgren 3596 (UC); Bluff Lake, shade of willows, 7400 ft, 13 Jul 1926, Munz 10690 (UC); Little Bear Valley, Aug 1884, Parish 1463 (UC-2 sheets); 1 mi ESE of Jenks Lake, Santa Ana R. drainage, shady creek bed, 7000 ft, 20 Aug 1932, Wheeler 1158 (UC). San Diego Co.: Palomar Mt., 5500 ft, 7 Apr 1928, Meyer 504 (UC); Palomar Mt., near Palomar Hotel, 4 Jul 1928, Meyer 504 (JEPS). Riverside Co.: San Jacinto Mts., Taquitz Valley, wet meadow, 7500 ft, 8 Aug 1903, Jepson 2300 (JEPS); Hannah's Sawmill, 1/2 mi E of Dutch Flat, edge of stream, ca. 6000 ft, 26 Jul 1928, Meyer 524 (UC 2 sheets); San Jacinto Mts., Taquitz Valley, on a stream bank, 3 Jul 1928, Meyer 601 (JEPS, UC).

Plants seemingly disjunct inland in Butte Co., California, are otherwise typical of the species. Examples: Butte Co.: Damp sand at S edge of Butte Creek, ca. 2.1 mi S of Skyway and ca. 1/4 mi E of Hwy 99 bridge, 29 Aug 1987, *Castro 213* (DAV); Chico, 28 Jul 1916, *Hazeltine s.n.* (DAV).

- 12. *Erythranthe pulisiferae*** (A. Gray) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus pulisiferae* A. Gray, Proc. Amer. Acad. Arts 11: 98. 1876. **LECTOTYPE** (Grant 1924, p. 212): **USA. California.** [Plumas Co.]: Indian Valley, 1873, *Mrs. Pulsifer-Ames 21* (GH). Gray cited "California, in the Sierra and Indian Valleys of the Sierra Nevada, Bolander, Mrs. Pulsifer-Ames." Grant (1924) cited *Ames 21* as the "Type."

**Annuals**, shallowly fibrous-rooted. **Stems** erect, 5–12(–18) cm, simple or sparingly branched at the base. **Stems and pedicels** minutely stipitate-glandular with gland-tipped hairs 0.1–0.3 mm. **Leaves** basal and cauline, blades elliptic-oblong to ovate or oblanceolate, 3–14(–23) mm x 2–9(–15) mm, palmately 3-veined, margins denticulate to entire, apex acute to obtuse, base cuneate to attenuate, petioles 2–9 mm. **Flowers** 1–5. **Fruiting calyces** cylindric, 7–10 mm, weakly to strongly inflated, stipitate-glandular, lobes subequal, 0.9–1.1 mm, triangular-acute, suberect, ciliate. **Fruiting pedicels** 12–38 mm, divergent-arcuate. **Corollas** yellowish, "limb pale yellow with pink edges, throat yellow," "white with yellow throat and pink border to the expanded limb," reddish dots present or not on the lower lip, tube-throats funnellform, 6–9 mm, limbs weakly bilabiate, lobes broadly obovate-suborbicular, apex rounded. **Styles** glabrous. **Anthers** glabrous. **Capsules** fusiform-cylindric, 5–8 mm.  $2n = 32$ . Map 6.

**Flowering** Apr–Jul. **Damp** depressions, moist gravel, rocky flats, granite outcrops, wet meadows, lava beds, vernal pools, forest openings, commonly in or near coniferous forest, also chaparral-live oak; 50–1300(–2500) m; Calif., Oreg., Wash.

*Erythranthe pulisiferae* is characterized by its minutely stipitate-glandular vestiture (lacking villous hairs), elongate internodes, persistent basal leaves, small, palmately veined, short-petiolate cauline leaves with elliptic-oblong to ovate or oblanceolate blades, divergent-arcuate pedicels, and small, weakly bilabiate corollas. *Erythranthe floribunda* is distinct from *E. pulisiferae* in its multicellular vestiture, urceolate fruiting calyces, and pinnately veined leaves with generally deltate to ovate blades and more strongly toothed leaf margins. The vestiture of *E. pulisiferae* is generally more similar to that of the Columbia River clade.

The anther pairs and stigma of *Erythranthe pulisiferae* are at essentially the same level and the species appears to be consistently autogamous over its range. Rare plants in Humboldt County (e.g., *Tracy 7616* and *12838*, JEPS) have slightly longer corolla tube-throats and broader limbs — in these the anther pairs are slightly separated and the stigma is at or slightly above the upper anther pair.

- 13. *Erythranthe arenaria*** (A.L. Grant) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus arenarius* A.L. Grant, Ann. Missouri Bot. Gard. 11: 215. 1924 [1925]. **TYPE: USA. California.** Fresno Co.: moist sandy places near Huntingdon Lake, 7000 ft, 5 Jul 1917, *A.L. Grant 1032* (holotype: MO!; isotypes: DS, GH, BH, JEPS!, OS digital image!, PH!, POM, RM, US digital image!).

*Mimulus subulatus* (A.L. Grant) Pennell, Proc. Acad. Nat. Sci. Philad. 99: 162. 1947. *Mimulus floribundus* var. *subulatus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 222. 1924. **TYPE: USA. California.** [Tuolumne Co.]: between Hog Ranch and Hetch-Hetchy Valley, 4200 ft, 16 Jun 1917, *A.L. Grant 970* (holotype: MO!; isotypes: GH, JEPS!, US digital image!).

*Mimulus multiflorus* Pennell, Proc. Acad. Nat. Sci. Philad. 99: 161. 1947. **TYPE: USA. California.** Fresno Co.: 4 mi E of Dunlop, moist granitic gravelly sand, 3700–3800 ft, 9 Aug 1940, *F.W. Pennell 26451* (holotype: PH!; isotypes: MO!, NY 2 sheets digital images!, US digital image!).

*Mimulus trisulcatus* Pennell, Proc. Acad. Nat. Sci. Philad. 99: 161. 1947. TYPE: USA. California. [Tulare Co.:] below Mineral King [western slope], moist gravelly granitic soil, 7000–7600 ft, 6 Aug 1940, F.W. Pennell 26421 with A. Cronquist (holotype: PH!; isotypes: MO!, NY 2 sheets digital images!, UCI, US digital image!).

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** erect to ascending, 5–20 cm, simple or branched. **Stems and pedicels** villous-glandular with gland-tipped hairs 0.2–0.8 mm. **Leaves** basal and cauline, blades elliptic to narrowly elliptic, ovate-elliptic, or ovate-lanceolate, 5–12(–17) mm x 3–7 mm, 1-veined or palmately 3-veined, margins entire to sparsely dentate to serrate, apex acuminate to acute or obtuse, base rounded to cuneate-attenuate, petioles essentially absent or proximally 1–3(–5) mm on proximal leaves. **Fruiting calyces** narrowly campanulate 5–7(–9) mm, not inflated or weakly so, often red-dotted, villous-glandular, lobes subequal, ca 1 mm, deltate-subulate to broadly triangular, suberect, ciliate. **Fruiting pedicels** 10–23 mm, divergent-arcuate. **Corollas** yellow with red-mottled lower lip, tube-throats funnelliform, 9–12(–14) mm, limbs weakly bilabiate, lobes broadly obovate, apex rounded. **Styles** glabrous. **Anthers** glabrous. **Capsules** elliptic, 4–7 mm.  $2n = 32$  (Heckard 4067, JEPS). Map 6.

**Flowering** May–Sep. **Sandy** flats, bars, gullies, washes, trails, and road cuts, seasonal creek beds and drainages, rocky slopes, seepy loam, ditches, lake edges, meadows, openings in pine-fir and pine-oak woodlands; (100–)500–2600(–2800) m; Calif. (Fresno, Los Angeles, Madera, Mariposa, Tulare, Tulomne).

Most plants of *Erythranthe arenaria* have relatively even-sized cauline leaves, all sessile to subsessile. Some, however, have persistent basal leaves that are short-petiole, ovate with a cuneate base, and relatively larger than the more distal cauline ones. Such plants are those named by Grant as *Mimulus floribundus* var. *subulatus*. These might be construed as showing influence of *E. geniculata*, but the latter occurs only at the lower range of elevation for *E. arenaria* and the "subulata" variants occur at least up to 2300 meters. The "subulata" variants also have the erect habit characteristic of *E. arenaria*. In any case, these variants should be investigated, especially in the Yosemite area where they appear to be relatively common, toward the possibility that they represent a distinct entity.

It is remarkable that Pennell described two species, based on his own collections and field observations, that appear to be essentially segregates from *Erythranthe arenaria*. Yet there do not appear to be discontinuities in corolla size or morphology, features he emphasized in descriptions of *Mimulus multiflorus* and *Mimulus trisulcatus*. Variability in overall size perhaps contributed toward recognition of *M. multiflorus*. California botanists perhaps will be able to corroborate Pennell's field observations of corolla variation and partition the variation more precisely.

Plants of a collection of *Erythranthe arenaria* from Mariposa County (N of Fish Camp, 4900–5100 m, Pennell 26392, UC) have mature calyces conspicuously longer (8–9 mm vs 5–7 mm) and more inflated than characteristic for the species and the corollas are slightly longer. Otherwise, they seem securely identified as *E. arenaria*.

Plants of the apparently disjunct collection from Los Angeles County are similar to those in counties further north: **Los Angeles Co.:** San Gabriel Mts., upper slopes of Little Rock Creek Canyon, ca. 1 mi W of Cedar Spring, sandy base of scree slope on N face of Kratke Ridge, 6800 ft, 20 Jul 1958, Baccigalupi 6416 (JEPS).

14. *Erythranthe floribunda* (Douglas ex Lindley) Nesom, Phytoneuron 2012-39: 38. 2012. *Mimulus floribundus* Douglas ex Lindley, Bot. Reg. 13: plate 1125. 1827. TYPE: USA. Washington. Protologue: "A neat hardy annual, found by Mr. Douglas on moist rocks in the interior of the districts of the river Columbia" (holotype: K?). Grant (p. 218) noted "on

- limestone rocks on dry sandy soils in the interior of the Columbia, 1826, *Douglas* (G, probably part of the type collection)."
- Mimulus peduncularis* Douglas ex Bentham, Scroph. Ind., 29. 1835. TYPE: USA. "America boreali-occident," 1826, *Douglas s.n.* (holotype: K, sketch and fragment of type at MO!). The full entry of the protologue is this "21. M. PEDUNCULARIS (Dougl. MSS.), pubescens, humilis, foliis petiolaris ovatis acutis subdentatis basi cuneatis rotundatisve, calycibus (parvis) ovato-tubulosis, dentibus brevibus acutis subaequalibus.— America boreali-occident. *Douglas*." Collected in 1826, *D. Douglas s.n.* (holotype: K, sketch of type at MO!).
- Mimulus deltoideus* Gandoger, Bull. Soc. Bot. France 66: 218. 1919. TYPE: USA. Oregon. [Lake Co.:] North Pine Creek, near Snake River, moist situations, 13 Jul 1899, *W.C. Cusick* 2237 (holotype: ?; isotypes: BH, MO!, OS digital image!, UC!).
- Mimulus serotinus* Suksdorf, Deutsche Bot. Monatsschr. 18:154. 1900. TYPE: USA. Washington. Klickitat Co.: damp sandy banks of the Columbia River, Oct-Dec 1892, *W.N. Suksdorf* 2185 (holotype: WS; isotypes: DS, MO!, NY digital image!, ORE digital image!, UC 2 sheets!, US digital image!; possible isotype: NY digital image!).
- Mimulus membranaceus* A. Nelson, Bot. Gaz. 34: 30. 1902. *Mimulus floribundus* var. *membranaceus* (A. Nelson) A. L. Grant, Ann. Missouri Bot. Gard. 11: 221. 1924. TYPE: USA. Wyoming. [Albany Co.:] Centennial Hills, 16 Jul 1894, *A. Nelson* 1683 (holotype: RM; isotypes: BH, GH, MO!, NY digital image!).

**Annuals**, fibrous-rooted or filiform-taprooted. Stems 3–22(–40) cm, erect to decumbent, sometimes procumbent-trailing, simple to many-branched. Stems and pedicels villous-glandular with gland-tipped hairs greatly variable in length and density, sometimes reduced to sparsely stipitate-glandular with hairs 0.2–0.5 mm. Leaves cauline, basal mostly deciduous by flowering, blades ovate, (3–)8–25(–35) mm  $\times$  (1–)5–18(–26) mm, pinnately to subpalmately veined, margins serrate to sparsely dentate, apex acute, base cuneate to truncate or cordate, petioles 1–12 mm. Fruiting calyces cylindric, 4–7 mm, weakly to strongly inflated, greenish or purplish to red-dotted, villous-glandular, lobes subequal, (0.5–)0.8–1.6(–2) mm, triangular-acuminate, suberect, ciliate. Fruiting pedicels 5–20(–26) mm. Corollas yellow with red-dotted lower lip, tube-throats funnellform-cylindric, (4–)5–10 mm, limbs weakly bilabiate, expanded 3–4 mm across (pressed), lobes mostly oblong, apically notched. Styles glabrous. Anthers glabrous. Capsules obovoid to elliptic, 3.5–7 mm.  $2n = 32$ . Map 7.

Flowering (Apr– in Arizona, May–)Jun–Aug(–Sep). Under overhangs, moist roofs of cave ruins, wet rock crevices, cliff faces and wet cliff bases, below waterfalls, seeps, springs, humus and moist soil over rocks and slabs, moist slopes, along ditches and pond edges, wet edges of creeks and rivers, drying mud on margins of wetland depressions, creek beds, wet or swampy meadows, along trails, in lodgepole pine, ponderosa pine, ponderosa pine-douglas fir, and spruce-fir woodlands; (1000–)1800–1600(–3100) m (ca. 300–500 m in Arkansas); Alta., B.C.; Ariz., Ark., Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., Wash., Utah, S.Dak., Wyo.; Mexico (Baja California, Baja California Sur, Chihuahua, Sinaloa, Sonora).

Collections have been made of plants much reduced in size — in leaves, flowers, and overall stature — so strikingly so that one might suspect that they are evolutionarily distinct, but the sizes appear to be at the lower limits of the species (as in the description above) and such plants are identified here as *Erythranthe floribunda*. The following is an example: Nevada. Nye Co.: Toiyabe Range, Toiyabe National Forest, Pine Creek Canyon, ca. 8500 ft, abundant along small stream, 13 Jul 1964, *Holmgren* and *Reveal* 1444 (TEX).

*Erythranthe floribunda* has been recognized from northern Arkansas (e.g., Moore 1958), where documented from a number of counties (Carroll, Cleburne, Crawford, Franklin, Izzard, Johnson, Logan, Newton, Pope, Searcy, Stone, and Washington). The unpublished name "*Mimulus floribundus* subsp. *moorei* Ilitis" has appeared in various checklists in reference to the Arkansas plants,

but observations in the current study of populations in the herbarium and field indicate that they are not distinct from the rest of the species. The disjunction in geography appears to be analogous to that in *E. moschata*.

Some plants identified here as *Erythranthe floribunda* in Arizona and southwestern New Mexico (e.g., Figs. 1–3) are distinctive in their prominently inflated calyces, sessile to subsessile leaves with attenuate bases and palmately 3–5-nerved venation, and much-elongated pedicels (20–43 mm), but intermediates in Arizona make it difficult to conclude that the variants represent an entity discontinuous from plants of typical morphology. This variant morphology has not been observed among Mexican populations.



Figure 1 *Erythranthe floribunda* variant from Hidalgo Co., New Mexico (one of several plants from Worthington 32511, SRSC)



Figure 2. *Erythranthe floribunda* variant from Hidalgo Co., New Mexico (Todsens n., NMC)





Figure 3. *Erythranthe floribunda* variant from Williams, Coconino Co. (Greene s.n., ND-Greene).

1. Cauline leaves basally attenuate to sessile or subsessile, epetiolate, blades oblanceolate to elliptic or elliptic-lanceolate, primarily palmately 3–5-nerved, sometimes with an additional 1–2 smaller lateral pairs; fruiting pedicels 20–43 mm, corolla tube-throats 5–6 mm, fruiting calyces 5–8 mm

**Arizona/New Mexico variant**

1. Cauline leaves abruptly and distinctly petiolate, blades generally ovate with a rounded to truncate or cordate base, mostly pinnately to subpalmately veined, fruiting pedicels 5–15(–26) mm, corolla tube-throats (4–)5–10 mm, fruiting calyces 4–7 mm

***Erythranthe floribunda***

Collections examined of the *Erythranthe floribunda* variant. **Arizona.** **Coconino Co.:** Williams, wet meadow, 6 Jul 1889, *Greene s.n.* (ND-Greene 2 sheets). **Pima Co.:** S end of Baboquivari Mts., in sand along edge of Presumido Wash near Buenos Aires, ca. 3000 ft, 3 Apr 1966, *Mason 2559* (ARIZ). **Santa Cruz Co.:** Meadow Hills Country Club, 4.5 mi N of Nogales, wet soil in marsh, [ca. 3900 ft,] 5 May 1966, *Crutchfield 1460* (LL); Santa Rita Mts., 4500 ft, 17 Apr 1903, *Thornber 505* (UC). **New Mexico.** **Hidalgo Co.:** 30 mi S of Animas, edges of ponds near Gray's Ranch and sandy banks of Animas Creek, 5000 ft, 19 Jun 1973, *Todsen s.n.* (NMC). Peloncillo Mts., Clanton Draw, 3.0 mi E of the [Coronado] National Forest, E side property line, 5480 ft, annual at edge of stream, 9 May 2004, *R.D. Worthington 32511* (NMC, SRSC, UNM, UTEP).

Previous tentative identifications on the three Hidalgo County sheets include *Mimulus floribundus*, *M. "probably floribundus," M. primuloides*, and *M. rubellus*. Similar ambiguity in identification of New Mexico collections recently confirmed as *Erythranthe suksdorfii* was noted by Keller (2010), but the New Mexico distribution of this species is north of Hidalgo County and the collections cited by Keller seem securely identified as *E. suksdorfii* (fide Phil Tonne, UNM).

A collection from southwestern Mexico is similar to *Erythranthe floribunda* but it is far-disjunct from other populations of that species, completely prostrate, and has very short pedicels: **Jalisco.** W of San Sebastian, Hacienda del Ototal, wet sand of stream bottom, 1500 m, *Mexia 1853* (UC). Fig. 4. It perhaps belongs with plants named by Bentham as *Mimulus pubescens*, which may prove to be a distinct species.

*Mimulus pubescens* Bentham, Prodr. (DC.) 10: 372. 1835. **TYPE: MEXICO.** **Jalisco.** "In Mexico prope Talisco," *Beechey s.n.* (holotype: K, photo MO!). The only information on the specimen is "Mexico, Beechey." See comments below.



Figure 4. *Erythranthe* from Jalisco, Mexico. Possibly what Benth. meant by *Mimulus pubescens* Benth. See comments below

15. *Erythranthe austrolatidens* Nesom, sp. nov. TYPE: MEXICO. Baja California Sur. Sierra Guadalupe, W of Mulege, W side of the mountain range, vicinity of Rancho El Tule, E of San Martin and La Vinorama, 26° 81' N, 112° 72' W, rocky volcanic substrate, with *Lysiloma candida*, *Opuntia cholla*, *Pachycereus pringlei*, ca. 260 m, 26 Apr 1998, Rebman 5170 (SD!).

Similar to *Erythranthe latidens* in its annual duration, fibrous roots, yellow, cleistogamous/autogamous flowers, sessile leaves, tubular campanulate calyces with 5 equal, deltate lobes; different in its short villous-glandular vestiture of stems, leaves, pedicels, and calyces, petiolate proximal leaves, consistently serrulate-denticulate leaf margins, generally smaller fruiting calyces, and disjunct geography in Baja California Sur.

Additional collections examined. MEXICO. Baja California Sur. Mpio. Comondú, La Laguna, al norte de San José de Comondú, matorral sarcocaula, 443 m, 26° 06' 48.2" N, 111° 46' 38.2" W, 14 Mar 2002, Dominguez L. 3136 (ARIZ-2 sheets, SD). Mpio. Comondú, Sierra La Giganta, Llanos de San Julio, 5 km al E de San José de Comondú, matorral xerófilo, 432 m, 19 Feb 2003, Dominguez L. 3399 (ARIZ). Mpio. de La Paz, Mison de Los Dolores, 3 km al SW del Rancho Los Dolores, 25° 03' 20.8" N, 110° 53' 28.1" W, matorral xerófilo, 85 m, 15 Mar 2003, Dominguez L. 3448 (SD).

**Annuals**, fibrous-rooted. **Stems** terete, 6–22 cm, nodes 3–5, branched mostly at the base, erect to erect-ascending. **Stems, leaves, pedicels, and calyces** short-villous-glandular with gland-tipped hairs 0.1–1.0 mm, without eglandular hairs. **Leaves** basal and cauline, basal often deciduous by flowering, largest at base or near midstem, cauline blades ovate to elliptic or obovate, 5–25 x 2–11 mm, basal blades to 30 mm long, 15 mm wide, palmately 3–6-veined, often suprabasal, margins consistently serrulate-mucronulate to -denticulate, (2–)4–6 teeth per side, apex sharply acute, base acute to cuneate, basal and lower cauline petiolate with petioles 1–6 mm. **Flowers** 5–13, from basal to distal nodes. **Fruiting calyces** tubular-campanulate, ovoid-ellipsoid, 5 angled, greenish with purple ribs, 8–9 mm x 3–5 mm, slightly inflated, lobes subequal, deltate-rounded, apex apiculate, margins weakly ciliate. **Fruiting pedicels** 5–30 mm. **Corollas** yellow, apparently without red markings, tube-throats cylindric, 7–8 mm, exerted 2(–3) mm beyond calyx margin, limbs nearly actinomorphic, barely widened, lobes obovate, apices rounded. **Styles** glabrous. **Anthers** glabrous. **Capsules** 4–6 mm, oblong to oblong-obovoid, stipitate. Map 3.

Flowering (Jan)–Feb–Apr. Xeric shrubland; ca. 100–250 m; Baja California Sur.

*Erythranthe austrolatidens* is similar to *E. latidens* in its overall aspect, but the differences in vestiture and leaf margins and base are readily apparent. These plants have mostly been identified as *E. floribunda*, to which it may be most closely related, but typical *E. floribunda* occurs all the way south in Baja California to the Cape Region. The new species is directly contrasted with both in the couplets below.

- 1 Vestiture villous-glandular, hairs 0.1–1.0 mm, basal and lower cauline leaves petiolate, margins consistently serrulate-mucronulate to serrulate-denticulate, (2–)4–6 teeth per side, fruiting calyces 8–9 mm x 3–5 mm

***Erythranthe austrolatidens***

- 1 Vestiture stipitate glandular, hairs 0.1–0.3 mm, all leaves sessile, margins entire or barely mucronulate to shallowly dentate-mucronulate, fruiting calyces 8–12 mm x 4–7 mm

***Erythranthe latidens***

- 1 Medial to distal cauline leaves sessile, stems erect to erect-ascending, mostly branched at the base

***Erythranthe austrolatidens***

- 1 All leaves petiolate, erect to decumbent, sometimes procumbent-trailing, branching at proximal to distal nodes

***Erythranthe floribunda***

16. *Erythranthe geniculata* (Greene) Nesom, Phytoneuron 2011-39: 38. 2011. *Mimulus geniculatus* Greene, Bull. Calif. Acad. Sci. 1: 280. 1885. *Mimulus floribundus* var. *geniculatus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 220. 1924. TYPE: USA. California. Kern Co.: Tehachapi, 1884, Mrs. Curran s.n. (holotype: CAS, fragment CAS 290198, fragment MO!; isotype: US digital image!). The CAS website provides this information: "Probably the holotype was lost in the 1906 fire. This [CAS 290198] is a fragment of that HT, returned by Pennell." The MO label (ex CAS) has handwritten "Part of the type."

*Mimulus dudleyi* A.L. Grant, Ann. Missouri Bot. Gard. 11: 235. 1924. TYPE: USA. California. Tulare Co.: rocky cliffs E of the Tule River, 27 Mar 1897, W.R. Dudley s.n. (holotype: DS digital image!).

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** ascending to decumbent or prostrate, 5–60 cm, simple to diffusely branched. **Stems and pedicels** moderately villous with multicellular eglandular hairs 0.8–2 mm and stipitate-glandular hairs 0.1–0.3 mm. **Leaves** basal and cauline or basal mostly deciduous by flowering, blades broadly ovate or elliptic-ovate to triangular, 8–35 x 5–30 mm, pinnately to subpinnately veined, margins serrate or dentate with 3–10 teeth per side, apex acute to obtuse or rounded, base cuneate to rounded or subcordate, petioles 2–10(–35) mm. **Fruiting calyces** campanulate-cylindric, (5)–6–8 mm, weakly inflated, ridged-angled, red-spotted, sparsely to moderately villous-glandular, lobes subequal, 1–3 mm, deltate to narrowly triangular or triangular-acuminate, usually apiculate or indurate, suberect to spreading-recurving, ciliate. **Fruiting pedicels** 12–26(–55) mm. **Corollas** yellow, red-spotted in throat, spots concentrated or becoming coalescent into a somewhat discrete blotch at the base of each of the 3 lower lobes and sometimes the 2 upper as well, tube-throats cylindric, 9–11 mm, limbs strongly to weakly bilabiate, expanded 8–14 mm across (pressed). **Styles** glabrous. **Anthers** glabrous. **Capsules** obovoid to elliptic, 4–6(–7) mm.  $2n = 32$  (reported as *Mimulus dudleyi*, Heckard 4003, UC). Figs. 5 and 6. Map 8.

Flowering (Mar–)Apr–Jul. Granite crevices, canyon slopes, and talus, crevices in volcanic outcrops (Butte and Tulare cos.), edge of boulders, roadsides, damp sandy soil, sandy water edges, gravelly soil and creek bottoms; 200–900(–1200) m; Calif.

Only a single collection of *Erythranthe geniculata* has been seen in the current study from each of Butte and Stanislaus counties: Butte Co.: North Table Mt., ca. 7 mi N of Oroville, face of basal cliffs on the S side of a small stream, ca. 100 yds S of the fence, ca. 1 mi NW of the parking area, cow chute, and Cherokee Road, basalt grassland, 1241 ft, 3 May 2006, Ahart 12,563 (UC). Stanislaus Co.: along Hwy 132 ca. 200 yards E of Basso Bridge, 2 mi SW of La Grange, wet soil beside pond, 27 May 1969, Allen 355 (DAV).

*Erythranthe geniculata*, like *E. arenaria*, has recently been treated as synonymous with *E. floribunda*. The latter, however, has much smaller corollas and is autogamous, while the flowers of *E. geniculata* and *E. arenaria* are larger, chasmogamous, and allogamous. In the original description of *Mimulus geniculatus*, Greene noted that it had corollas twice the size of *M. floribundus*. The anther pairs of *E. geniculata* and *E. arenaria* are at different levels and the stigma is slightly above the upper anther pair, while in *E. floribunda* both anther pairs and the stigma are at the same level.

*Erythranthe geniculata*, *E. arenaria*, and *E. norrisii* constitute a group of apparently closely related species endemic along the Sierra Nevada. All have ovate-petiolate leaves (only the basal are sometimes ovate in *E. arenaria*) with pinnate to subpinnate venation. The more widespread *E. floribunda*, which is part of the group, also is similar but the three endemics have larger corollas with the tube-throats exerted at greater length beyond the calyx margin.



Figure 5. *Erythranthe gemiculata*. Granite-Woody Rd., Kern Co., California. Photo by Mark Egger, 3 April 2010.



Figure 6. *Erythranthe gemiculata*. Indian Wells Canyon, Kern Co., California. Photo by Naomi Fraga, 15 April 2011

17. *Erythranthe norrisii* (Heckard & Shevock) Nesom, Phytoneuron 2012-39: 39. 2012. *Mimulus norrisii* Heckard & Shevock, Madroño 32: 179. 1985. TYPE: USA. California. Tulare Co.: Comb Rocks above Washburn Cove, 2 mi N of Three Rivers, 2800 ft, 1 May 1983, L.L. Norris 389 (holotype: JEPS!; isotypes: CAS, FSC, K, MO, NY digital image!, RSA).

**Annuals**, fibrous-rooted or filiform-taprooted. **Stems** ascending to erect-ascending, 2–15(–25) cm, commonly branched from lower nodes. **Stems and pedicels** villous-glandular. **Leaves** basal and cauline, blades elliptic to elliptic-obovate, 20–35 mm x 10–20 mm, 3–5-palmately veined, sometimes with 1–3 distal vein pairs diverging pinnately, surfaces minutely villous-glandular, margins subentire to distally denticulate, apex acute to obtuse, base mostly attenuate, petioles 5–10(–15) mm. **Fruiting calyces** campanulate, 4–6 mm, weakly inflated, villous-glandular, sulcate between rounded and thickened ribs, lobes subequal, 1.5–2 mm, linear-oblong to oblong-lanceolate with rounded to blunt apices, often incurved, villous. **Fruiting pedicels** 20–35(–50) mm, villous-glandular. **Corollas** yellow with a prominent maroon blotch at the base of each lobe and white patch at the 2 sinus bases of the lower lip, weakly bilabiate to regular, sometimes nearly rotate, tube-throats cylindric-funneliform, 12–16 mm, limbs bilabiate, expanded 15–30 mm (pressed), lobes oblong-obovate to obicular-obovate, apex rounded-truncate. **Styles** glabrous. **Anthers** glabrous. **Capsules** narrowly ovoid, 4–6 mm, often slightly exerted.  $2n = 32$ . Map 8.

Flowering Mar–May. Steep marble outcrops in soil pockets, moss covered marble and quartzite ledges, cracks, fractures, and weathered faces, chamise chaparral or blue oak woodland; 300–1300 m; Calif. (Tulare and Fresno counties).

*Erythranthe norrisii* is known only from the Kaweah River drainage and most populations are in Sequoia National Park. The species is characterized by its short-petiolate leaves with attenuate bases, very large corollas with red blotches at the base of each lobe and two white patches on the lower lip, very short, purple-dotted calyces with rounded-thickened ribs and with linear-oblong lobes incurved in fruit. The capsules often extend beyond the apex of the mature calyces.

#### Species of Asia.

18. *Erythranthe stolonifera* (Novopokr.) Nesom, Phytoneuron 2012-39: 39. 2012. *Mimulus stolonifer* Novopokr., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 11: 158 [with Latin] and 155 [Russian only]. 1949. TYPE. RUSSIA. Province Primorskaja, sinus Nachtau [Gulf of Nakhtau], 28 Jun 1911, *Desslavi 1599* (holotype: LE).

*Erythranthe stolonifera* (Fig. 6) is endemic to the Ussuri region of Russia (Cape Olympiad, Gulf of Nakhtau, Nelka Bay; fide Novopokrovsky 1949), a coastal extension that is essentially opposite the islands of Sakhalin (Russia) and Hokkaido (Japan), bordered on the west by northeastern China and on the south by North Korea. Plants produce procumbent stems rooting at the nodes and arising from a system of lignescent rhizomes. As noted in the protologue, the plants also produce distally small-leaved runners from basal cauline nodes. The species is characterized by glandular-villous vestiture, essentially ovate, petiolate, pinnately to subpinnately veined leaves with dentate margins, long pedicels, and yellow corollas with infundibular tube-throats. It seems likely that its closest relative is the North American *Erythranthe moschata* group (*E. moschata*, *E. moniliformis*, *E. inodora*).



Figure 7 Collection of *Erythranthe stolonifera* from Primorsky Province, Russia



### Excluded species.

*Erythranthe bridgesii* (Benth.) Nesom (Phytoneuron 2012-n: 0. 2012) was placed by Von Bohlen (1995) in the relationship of *Mimulus moschatus* and *M. floribundus*, especially based on similarities in pollen morphology and perhaps with a tacit assumption that it was related to *M. moschatus*. The placement of *E. bridgesii* within sect. *Mimulosma*, however, is problematic, especially in view of its glabrous vestiture, strongly palmately veined leaves, and truncate calyx margins. The species is tentatively placed as a continentally disjunct member of *Erythranthe* sect. *Sinopithecus* (Barker et al. 2012), with which it shares glabrous vestiture, sessile, palmately veined leaves, calyces with shallowly lobed to subtruncate margins, and broadly spreading, nearly regular corolla limbs.

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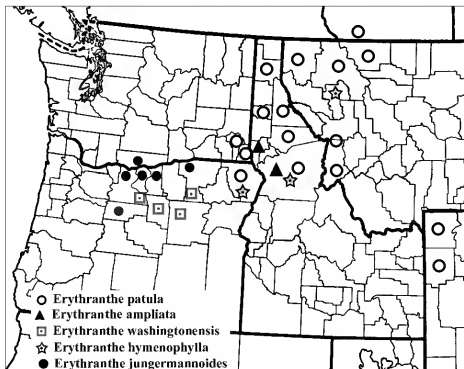
Many thanks to ARIZ, NMC, SD, SRSC, and UC-JEPS for loans of *Mimulus* *sensu lato* to TEX (where studied), TEX staff for arranging and handling the loans, Amber Schoeneman at TEX for the photos of *Erythranthe plotocalyx*, Phil Tonne at UNM for checking the identity of UNM collections filed as *Mimulus suksdorfii*, Mark Egger and Naomi Fraga for permission to publish photos from their web pages, Theo Witsell for company and guidance on a field trip to see *Erythranthe floribunda* in Arkansas, and to DAV, MO, ND-Greene, PH, SMU-BRIT-VDB, TEX-LL, UC-JEPS, and UT for help and hospitality during study there. I'm grateful to Naomi Fraga for comments on the manuscript and particularly to Matt Carlson sending his dissertation and providing a detailed commentary as well as various suggested extensions and modifications. Citations of herbaria for duplicates of some types not seen in the present study are from Meinke (1992). This study has been supported in part by the Flora of North America Association.

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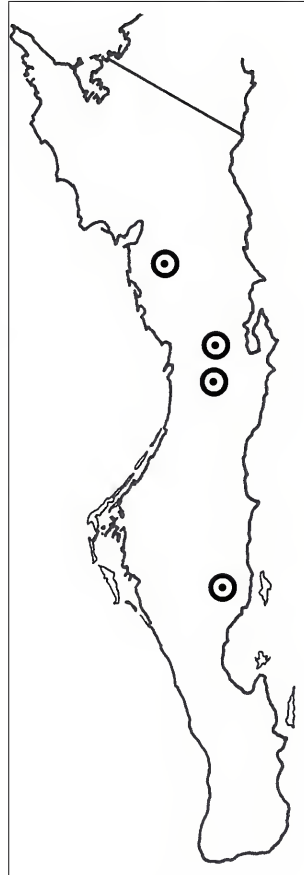
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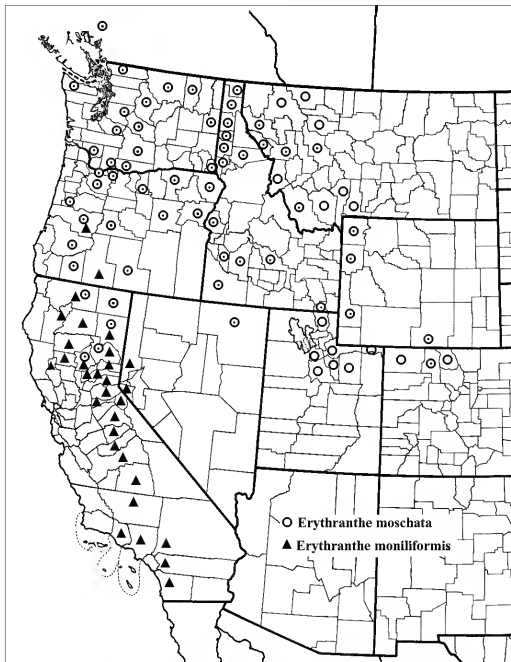
Map 1: *Erythranthe jungermannoides*, *E. washingtonensis*, *E. hymenophylla*, *E. ampliata*, and *E. patula*.



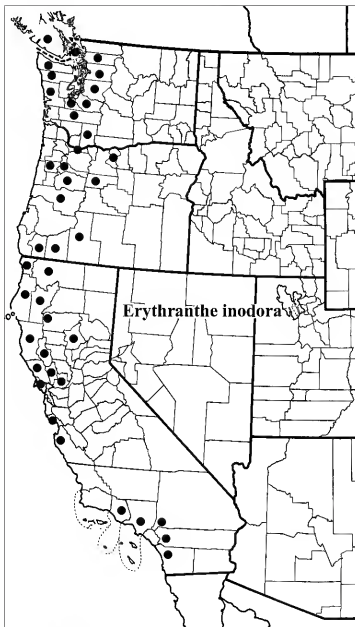
Map 2. *Erythranthe latidens*, *E. breviflorus*, and *E. inflatula*. Undotted symbols are reports from literature, vouchers not seen in present study.



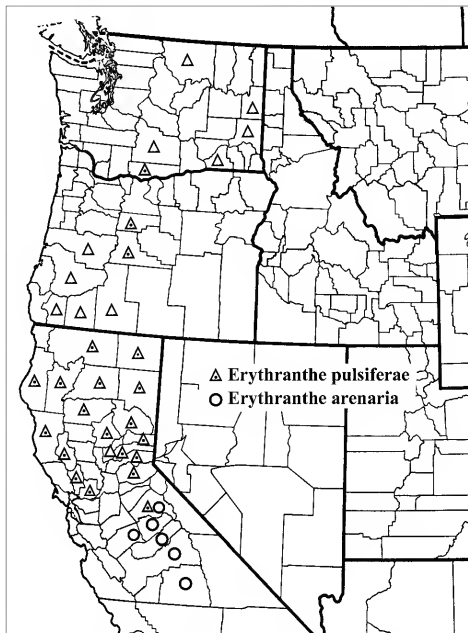
Map 3. *Erythranthe austrolatidens*.



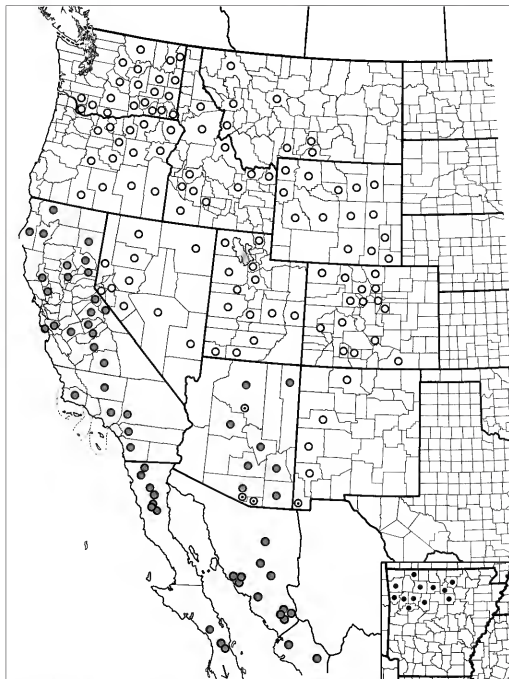
Map 4. *Erythranthe moschata* and *E. moniliformis*. Undotted circles are reports from literature, vouchers not seen in present study



Map 5. *Erythranthe inodora*.



Map 6. *Erythranthe pulcherrima* and *E. arenaria*. Undotted symbols are reports from literature, vouchers not seen in present study



Map 7 Distribution of *Erythranthe floribunda*. Inset show disjunct distribution in Arkansas. Dotted circles in Arizona and New Mexico are variant discussed in text. The distribution in Baja California Sur continues to the Cape Region. California records from UC-JEPS, Arizona and Mexico records are from ARIZ, TEX-LL, and SD. Other records are from various sources, vouchers seen for some but not all.





## TAXONOMIC SUMMARY OF *ERYTHRANTHE* SECT. *ACHLYOPITHECA* (PHRYMACEAE)

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### ABSTRACT

*Mimulus acutidens* and *M. grayi* have recently been treated as synonyms of *M. inconspicuus*, but all three species are amply distinct and non-intergrading while broadly sympatric. Each is treated here within the genus *Erythranthe* and together constitute sect. *Achlyopitheca*. Typifications, descriptions, county distributions, and a key to the species are provided.

**KEY WORDS:** *Mimulus*, *Erythranthe* sect. *Achlyopitheca*, *Erythranthe acutidens*, *Erythranthe grayi*, *Erythranthe inconspicuus*

Grant (1924) described *Mimulus grayi* A.L. Grant and placed it in sequence between *M. acutidens* and *M. inconspicuus*. She noted (p. 205-206) that the latter "is the most common species in a closely related group of plants consisting of *M. inconspicuus*, *acutidens*, *latidens*, and *Grayi*. ... They all have ovate leaves closely sessile by a broad, 3–5-nerved base, strongly plicate, inflated mature calyces with short broad teeth, subglobose villous anthers, and stipitate capsules." All are annuals with purplish (to yellowish in *M. inconspicuus*) corollas. *Mimulus latidens* differs from the others in its glabrous vestiture (vs. essentially glabrous) and is placed in a different relationship in an infrageneric classification (Barker et al. 2012, primarily following the phylogenetic hypothesis in Beardsley et al. 2004). In the classification of Barker et al., *M. inconspicuus*, *M. acutidens*, and *M. grayi* are treated in the genus *Erythranthe* Spach, where they constitute sect. *Achlyopitheca*.

Pennell (1951) and Munz (1959) recognized all three species of sect. *Achlyopitheca*. Thompson (1993), however, without comment, included *Mimulus acutidens* and *M. grayi* as synonyms of *M. inconspicuus*. Beardsley et al. (2004) observed that all three are distinct on the basis of molecular data and the present study confirms that observation on the basis of morphology. Differences among them might appear to be relatively subtle but they nevertheless are consistent. The geographic range of each of the three species is essentially restricted to the Sierra Nevada of California and all three occur in Fresno, Kern, Madera, Mariposa, and Tulare counties (Fig. 1). *Mimulus acutidens* and *M. grayi* have essentially congruent ranges and both are sympatric with the more broadly distributed *M. inconspicuus*.

**Erythranthe** sect. **Achlyopitheca** Nesom & Fraga, Phytoneuron 2012-n: 0. 2012. TYPE: *Erythranthe inconspicuus* (A. Gray) Nesom

**Annuals**, stems, pedicels, leaves, and calyces usually glabrous, eglandular. **Leaves:** basal persistent as a rosette, cauline sessile to subsessile (proximal rarely short-petiolate), blades broadly elliptic to ovate or broadly ovate; fruiting pedicels usually longer than calyces. **Calyx** inflated in fruit, lobes shallowly deltate-mucronulate to deltate-apiculate, the apical calyx margin appearing subtruncate. **Corollas** usually rose to light lavender, less commonly yellowish, caducous, weakly bilabiate, lobes broadly obovate to oblong with deeply notched apices, ventral ridges yellow-lined. **Anthers** included, stamens minutely villous-hirsute, hairs sometimes reduced and papilliform. **Capsules** stipitate. Base chromosome number unknown.

1. Corolla tubes 5–9 mm, limbs expanded 5–6 mm (pressed); both anther pairs and the stigma at the same level (autogamous); fruiting pedicels 5–15 mm ..... ***Erythranthe inconspicua***  
 1. Corolla tubes 8–12 mm, limbs expanded 7–12 mm (pressed); anther pairs at different levels, stigma slightly or well above upper anther pair (herkogamous); fruiting pedicels 6–7 mm or 10–23 mm.

2. Fruiting pedicels 6–7 mm, shorter than the subtending leaves ..... ***Erythranthe grayi***  
 2. Fruiting pedicels 10–23 mm, longer than the subtending leaves ..... ***Erythranthe acutidens***

Based on his field experience, Pennell (1951) provided further distinctions among them — the contrasts below are extracted from his key, with slight augmentation from Grant (1924).

1. Corollas yellowish to purple ..... ***Erythranthe inconspicua***  
 1. Corollas purple.  
 2. Ventral ridges within corolla sharp, yellow against rosy background, finely pubescent ..... ***Erythranthe grayi***  
 2. Ventral ridges of corolla less pronounced, the whole platform of the lower lip yellow and pilose ..... ***Erythranthe acutidens***

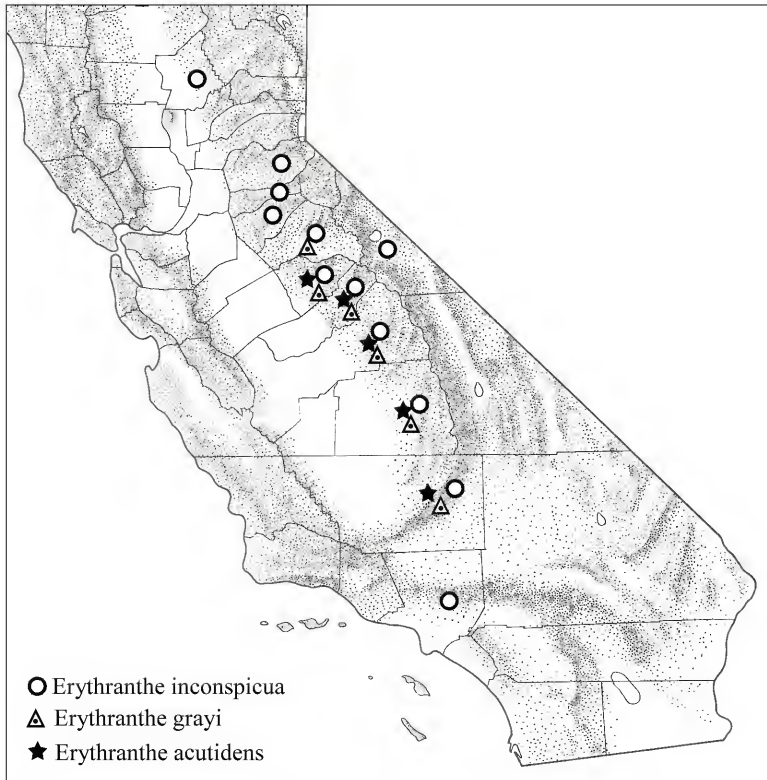


Figure 1. Distribution of *Erythranthe* sect. *Achlyopitheca*.

1. *Erythranthe inconspicua* (A. Gray) Nesom, Phytoneuron 2012-39: 34. 2012. *Mimulus inconspicuus* A. Gray, Pacific Railr. Rep. 4, Pt. 5, No. 4 (Whipple), 120. 1857. TYPE: USA. California. Los Angeles Co.: Los Angeles, damp hillsides, 14 May 1854, J.M. Bigelow s.n. (holotype: GH; isotype: US digital image!).

**Annuals**, fibrous-rooted. **Stems** erect to ascending, 3–16 cm, simple or branched from the base, 4-angled. **Leaves:** blades broadly elliptic to ovate or broadly ovate, 6–20 mm x 6–12 mm, palmately 3-veined, sparsely villous, apex obtuse to acute or acuminate, base rounded to cordate, margins subentire to denticulate; petioles (proximal leaves) 1–5 mm, midcauline and distal leaves petiolate and sessile. **Fruiting pedicels** 5–15 mm, usually longer than subtending leaves. **Fruiting calyces** campanulate, 6–9 mm x 3–3.5 mm, lobes unequal to subequal, 0.5–1 mm, broadly deltate, ciliate. **Corollas** pale pink to rose pink or purple to magenta, throat sometimes yellow, lobes sometimes yellowish with pale rose spots, tubes cylindric, 5–9 mm, exserted 1–3 mm beyond calyx margin, limb expanded to 5–6 mm (pressed). **Anther pairs** at essentially the same level, stigma at same level or below both anther pairs or in between them.

Flowering Apr–Jun(–Jul). Steep, N- or NW-facing slopes, canyon walls, moist talus, granitic sand on outcrops, moist gravelly open spots, sandy lake shores, hillside streams or seeps riparian woodland, grassy slopes, digger pine, yellow pine, yellow pine-Kellogg oak, chaparral, *Pseudotsuga-Pinus-Cornus*, canyon live oak; 200–2100 m; California (Amador, Butte, Calaveras, Eldorado, Fresno, Inyo, Kern, Los Angeles, Madera, Mariposa, Tulare, and Tuolumne counties).

The floral morphology of *Erythranthe inconspicua* indicates that it is autogamous; at least the smallest corollas appear to be cleistogamous.

2. *Erythranthe grayi* (A.L. Grant) Nesom, Phytoneuron 2012-39: 34. 2012. *Mimulus grayi* A.L. Lewis, Ann. Missouri Bot. Gard. 11: 203. 1924. TYPE: USA. California. Mariposa Co.: Mariposa, May 1882, J.W. Congdon s.n. (holotype: GH; isotype: PH!).

**Annual**, fibrous-rooted. **Stems** erect, 8–20 cm, simple or branched from the base, slightly 4-angled. **Leaves:** blades broadly ovate, 7–18 mm x 5–12 mm, palmately 3–5-nerved, margins denticulate, apex acute, base rounded, sessile, glabrous or rarely sparsely puberulent. **Fruiting pedicels** 6–7 mm, shorter than subtending leaves. **Fruiting calyces** campanulate, 9–11 mm x 5–6 mm, sometimes densely papillate at flowering with tiny, 1-celled, eglandular hairs, these apparently deciduous by fruiting, lobes deltate-apiculate, ciliate. **Corollas** rose red with pink throat lined with rose-red and with a yellow patch, ventral ridges yellow, tubes cylindric-funnelform, 8–11 mm, exserted 3–5 mm beyond calyx margin, limb expanded 7–10 mm (pressed). **Anther pairs** separated; stigma slightly above or at same level as upper anther pair.

Flowering May–Jul(–Oct). Drying pond beds, creek banks, yellow pine, yellow pine-libocedrus; 1000–1900 m. California (Fresno, Kern, Madera, Mariposa, Tulare, and Tuolumne counties).

In addition to features noted in the key and descriptions, the fruiting calyces of *Erythranthe grayi* are distinctly more inflated than those of *E. acutidens* and *E. inconspicua*.

3. *Erythranthe acutidens* (Greene) Nesom, Phytoneuron 2012-39: 34. 2012. *Mimulus acutidens* Greene, Bull. Calif. Acad. Sci. 1: 117. 1885. *Mimulus inconspicuus* var. *acutidens* (Greene) A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 450. 1886. TYPE: USA. California. [Fresno Co.:] King's River Mountains, 4000 ft, Apr 1877, Dr. G.A. Eiken s.n. (holotype: GH).

**Annuals**, fibrous-rooted. **Stems** erect to ascending-erect, 7–20 cm, simple to diffusely branched, 4-angled. **Leaves:** blades ovate to broadly ovate, 10–20 mm x 7–11 mm, palmately 3–5

nerved, margins serrate denticulate, apices acute, base rounded to truncate, sessile. **Fruiting pedicels** 10–23 mm, divergent-arcuate, sometimes becoming deflexed, longer than subtending leaves. **Fruiting calyces** campanulate, 7–9 mm x 3–4 mm, lobes subequal to unequal, 0.5–1 mm, deltate, ciliate. **Corollas** pale pink to rose purple, tubes cylindric-funnelform, 9–12 mm, exerted 4–5 mm beyond calyx margin, throat yellow or "deep pink on the outside with two yellow spots below the lower lip," limbs expanded 9–12 mm (pressed). **Anther pairs** separated; stigma slightly to well above level of upper anther pair.

Flowering Apr–Jul. grassy slopes, sandy terraces, marshy places, lake shores, creek sides, seep edges, shaded canyon slopes, road cuts and roadsides, woodlands of *Pseudotsuga menziesii*-*Quercus chrysolepis*, oak-digger pine, interior live oak; 200–2000 m; California (Fresno, Kern, Madera, Mariposa, and Tulare counties).

#### ACKNOWLEDGEMENTS

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## NOTES ON *ERYTHRANTHE ORIZABAE* (PHRYMACEAE)

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### ABSTRACT

*Erythranthe orizabae* (synonyms: *Mimulus pachystylus*, *Mimulus orizabae*) occurs from Guatemala north in Mexico to Veracruz and Hidalgo. Its closest relatives are hypothesized to be a group of six species of southeastern Asia, from Japan through China to the Himalayas. Typification and a description of *E. orizabae* are provided and citation of representative specimens documents its known geographic distribution.

**KEY WORDS:** *Mimulus pachystylus*, *Mimulus orizabae*, *Erythranthe orizabae*, Mexico

Study of *Mimulus* in the broad sense, in preparation of the FNANM treatment and in anticipation of recognizing segregate genera, has resulted in a better understanding of a species endemic to Guatemala and southern Mexico. *Mimulus pachystylus*, as treated by Grant (1924) and generally recognized as such elsewhere (e.g., Standley & Williams 1973) proves to have an earlier name and has been treated by Barker et al. (2012) within the genus *Erythranthe* Spach.

**Erythranthe orizabae** (Benth.) Nesom, Phytoneuron 2011-39: 41. 2012. *Mimulus orizabae* Benth., Prodr. (DC.) 10: 372. 1846. **TYPE:** MEXICO. [Veracruz, presumably:] "In monte Orizabae Mexicanorum," April 1838, *J. Linden 1092* (holotype: K digital image! photo-MO!).

*Mimulus pachystylus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 234. 1924. **TYPE:** MEXICO. Chiapas. Cerro del Boqueron, Aug 1913, *C.A. Purpus 7015* (holotype: MO!; isotypes: BM, F digital image!, UC, US digital image!).

**Perennial**, rhizomatous and rooting at the nodes. **Stems** prostrate, 10–30 cm, mostly simple, lignescent. **Stems and pedicels** arachnoid-villous with multicellular hairs with colored crosswalls, eglandular. **Leaves:** basal not persistent; blades ovate to broadly ovate, 10–30 mm x 5–20 mm, venation suprabasal-acrodromous (pinnate) with slight tendency to appear brochidodromous (Fig. 3), glabrous on both surfaces or coarsely pilose abaxially along veins, eglandular, margins coarsely dentate to serrate, apex acute to obtuse, base rounded, petioles 3–9 mm. **Calyces** in flower 9–12 mm and campanulate, in fruit 12–16 mm and cylindric-campanulate, weakly inflated, crinkly villous on the angles with long hairs with colored crosswalls, lobes subequal, erect, convex to deltate-subulate or nearly obsolete and represented only by a mucro, the calyx apex then nearly truncate except for the slightly longer upper lobe. **Fruiting pedicels** 10–20(–60) mm. **Corollas** yellow, with 2 lines of red dots along the bottom of the tube, tube cylindric-funneliform, 12–16 mm, strongly bilabiate and sagittally compressed, throats open, ventral ridges prominent. **Anthers** included, glabrous. **Capsule** included, narrowly elliptic-ovoid, 7–9 mm; placentation axile. Chromosome number not reported.

**Flowering** Mar–Aug. Cloud forest, oak woods; 1700–3100 m; Guatemala, Mexico (Chiapas, Hidalgo, Oaxaca, Veracruz).

**Representative collections.** GUATEMALA. Mpio. San Mateo Ixcátán, cloud forest near the place called Kurus Lemun, 4 mi E of San Mateo Ixcátán along road to Barillas, 8500 ft, 7 Aug 1965, *Breedlove 11642* (MO); [Depto. Escuintla,] Santa Rosa, near Escuintla, in virgin forest, 1600 m, 20 Jun 1941, *Matuda 4246* (LL, MO). MEXICO. Chiapas. Mpio. San Cristóbal las Casas, steep NE slope of Zonchuitz, heavily wooded, 9300 ft, 11 Jul 1966, *Breedlove 14525* (MO); [Mpio. Siltepec,] [Santa Isabel Ziján] Fraylesca, near Siltepec, 11 Mar 1945, *Matuda 5234* (LL-2 sheets);



Figure 1. Isotype collection of *Mimulus pachystylus* A.L. Grant (US).



Figure 2. Leaf of *Erythranthe orizabae* (from US isotype of *Mimulus pachystylus* shown in Fig. 1).

Cerro del Boqueron, Aug 1913, *Purpus* 7015 (UC) **Hidalgo**, Mpio. de Tenango de Doria, 10 km al W de Tenango de Doria, bosque de encinos, ailes y *Liquidambar* principalmente, 1700–1800 m, 10 May 1980, *Hernandez Magaña* and *Hernandez V* 4311 (MO) **Oaxaca** Mpio. San Felipe Usila, cuenca del Río Perfume (ladera), 7.5 km en línea recta al S de Santa Cruz Tepetotutla, en un arroyo, bosque mesófilo de montaña, 2230 m, 3 Apr 1994, *Gallardo H et al* 1044 (MO)

Grant (1924) included a brief description of *Mimulus orizabae*, essentially translated from Bentham's protologue, and placed it among a group of "doubtful and little-known species." Her description of *Mimulus pachystylus* was much fuller. She knew the species only from Chiapas but collections are recorded here from Guatemala, Chiapas, Oaxaca, Puebla, Veracruz (whence the type of *Mimulus orizabae*), and Hidalgo. No species of *Mimulus*, however, has apparently been previously included in accounts of the Veracruz flora (see comments by Durán-Espinoza 2006), nor was *Mimulus orizabae* reported by Rodríguez J. (2001) for the Valley of Mexico.

The generic placement of *Erythranthe orizabae* is indicated by its parietal placentation, relatively long pedicels, and suprabasal-acrodromous leaf venation. As a species, it is characterized by herbaceous, prostrate stems rooting at the nodes, young stems and adaxial leaf surfaces arachnoid-villous with long, viscid, crinkly hairs sometimes with colored cross walls, leaves petiolate with ovate, pinnately veined, serrate-margined blades, sometimes bicolored with a lighter abaxial surface, and yellow, bilabiate and strongly sagittally compressed corollas with an open throat.



*Erythranthe orizabae* is superficially similar to *E. moschata* (Douglas ex Lindl.) Nesom, which has prostrate to ascending stems and petiolate leaves, but the latter occurs in the northern USA and Canada and *E. moschata* and its closest relatives (*Erythranthe* sect. *Mimulosma*, Nesom 2011) are characterized by a vestiture that includes stipitate-glandular hairs. The closest evolutionary relationship of *E. orizabae* is hypothesized here to be with a group of species otherwise similar to sect. *Mimulosma* but mostly without glandular hairs and with more pronounced suprabasal-acrodromous venation — *Erythranthe* sect. *Mimulasia* (see Barker et al. 2012), species mostly of southeastern Asia from Japan through China to the Himalayas but also including *E. dentata* (Nutt. ex Benth.) Nesom of the Pacific Northwest.

#### ACKNOWLEDGEMENTS

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## A NEW SPECIES OF *ERYTHRANTHE* (PHRYMACEAE) FROM CHINA

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### ABSTRACT

*Erythranthe sinoalba* Nesom, sp. nov., is described from Yunnan, China. It is an erect, rhizomatous perennial with large, white, red-dotted corollas, ovate, petiolate leaves, relatively long pedicels, and puberulent-glandular pedicels and petiole margins. Its closest relatives are hypothesized to be Asian species of *Erythranthe* sect. *Mimulasia*.

**KEY WORDS:** *Erythranthe sinoalba*, *Mimulus*, *Phrymaceae*, China

While studying Asian and Southern Hemisphere species of *Mimulus* sensu lato in preparation for recognition of generic segregates, a new and distinctive species has come to light. The collection was made on a botanical expedition to Gaoligongshan sponsored by the Kunming Institute of Botany and supported by the National Geographic Society (KUN-NGS). With parietal placentation, flowers on long pedicels, and suprabasal-acrodromous venation, it is placed in the genus *Erythranthe* (Barker et al. 2012).

*Erythranthe sinoalba* Nesom, sp. nov. Fig. 1. **TYPE:** CHINA. Yunnan. Gongshan. Cikai Zheng. E side of Gaoligong Shan, along the Danzhu He on the road from Nu Jiang at Danzhu to the Myanmar border, 27° 37' 49" N, 98° 37' 18" E, 2650 m altitude, mixed broad-leaved evergreen and coniferous forest with most of the conifers recently cut and removed; growing on wet rock faces above road, flowers white with reddish specks at base of throat, 1 Jul 2000, Li Heng 11827 (MO). Eight duplicates were collected, as noted on the label.

Similar to *Erythranthe procera* (A.L. Grant) Nesom of southeast Asia in its tall, erect, single-stemmed habit but the leaves larger with more coarsely serrate margins, pedicels and nodal regions puberulent-glandular with gland-tipped hairs, longer pedicels, and corollas white with longer tubes.

**Perennial** herbs, rhizomatous. **Stems** erect to ascending-erect, 30–40 cm, simple with branches beginning to develop at flowering, glabrous. **Leaves** mostly cauline, largest distally, basal greatly reduced in size, petiolate, blades ovate to elliptic-ovate, venation suprabasal-acrodromous (pinnate) with 2–7 veins per side, margins coarsely serrate with 3–9 teeth per side, apex acute, base cuneate, petioles 3–10 mm long, margins of petiole bases sparsely glandular-puberulent. **Fruiting pedicels** ca. 25 mm long, straight, erect to erect-ascending, sparsely glandular-puberulent with gland-tipped multicellular hairs 0.1–0.6 mm long. **Calyces** green, tube 12 mm long, obtriangular, 5-angled but not distinctly ridged or winged, in fruit elongating to 12–14 mm and becoming broadly ellipsoid-inflated, lobes narrowly triangular with caudate-attenuate apices, 2 mm long. **Corollas** white, drying slightly yellowish, with reddish dots at base of throat, bilabiate, tube narrowly funnelliform, 32–34 mm long, lobes orbicular-obovate with retuse apices, the limb expanded and ca. 20–25 mm wide. **Stamens** glabrous, included, shorter than the style. **Style** pubescent, included. **Fruit** broadly ellipsoid, 10 mm long.



Figure 1. *Erythranthe sinoalba* Nesom (holotype).

*Erythranthe sinoalba* is similar in its tall, erect, single-stemmed habit and pinnately veined (suprabasal-acrodromous) leaves to the species of *Erythranthe* sect. *Mimulasia*, which includes nine southeast Asian species (see Barker et al. 2012) as well as the Mexican-Central American *E. orizabae* (Nesom 2011b), and *E. dentata* (Nutt. ex Benth.) Nesom of the Pacific Northwest. It differs from all of these, however, in its larger and white corollas (the others have yellow corollas) and particularly in its pedicels and petiole margins distinctly puberulent with gland-tipped hairs (all of the other species of sect. *Mimulasia* are eglandular).

Molecular analyses indicate that *Erythranthe* sect. *Mimulosma*, which is primarily American and characterized by glandular vestiture, has a sister relationship to sect. *Mimulasia*. The glandularity of *E. sinoalba* is interpreted here as further evidence of the close relationship of sect. *Mimulasia* to sect. *Mimulosma*. The only other Asian species of sect. *Mimulosma* is the Russian *E. stolonifera* (Novopokr.) Nesom, which has prostrate-creeping stems similar to those of *E. moschata* (Douglas ex Lindl.) Nesom of the northern USA and Canada.

Other species of *Mimulus* sensu lato in southeastern Asia (e.g., Deyuan & Wen 2011; Ohwi 1984) are of different relationships and distinctly different from *Erythranthe* sects. *Mimulosma* and *Mimulasia* in various morphological aspects: *Mimulus bracteosus* (treated by Barker et al. 2012 as *Mimulus* sensu stricto); *Mimulus tibeticus* and *M. platyphyllus* (placed by Barker et al. 2012 in *Erythranthe* sect. *Snopitheca*).

#### ACKNOWLEDGEMENTS

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## TAXONOMIC OVERVIEW OF *DIPLACUS* SECT. *DIPLACUS* (PHRYMACEAE)

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### ABSTRACT

A study of *Diplacus* sect. *Diplacus* recognizes twelve taxa of the USA at specific rank: *D. aridus*, *D. aurantiacus*, ***Diplacus* x *australis*** (McMinn ex Munz) Tulig, **comb. nov.**, *D. calycinus*, *D. clevelandii*, *D. grandiflorus*, *D. x linearis* (Benth.) Greene, *D. x lompocensis* McMinn *D. longiflorus*, *D. parviflorus*, *D. pumiceus*, and *D. rutilus*. A thirteenth species, *D. stellatus*, is an endemic of Cedros Island, Baja California. The hypothesized hybrid taxa appear to function in the same way as others recognized at specific rank. A key to the taxa, distribution maps, and formal nomenclatural summaries are included.

**KEY WORDS:** *Diplacus*, *Mimulus* sect. *Diplacus*, *Diplacus aurantiacus*, Phrymaceae

Various botanists have studied the primarily Californian group of *Mimulus* species characterized by sessile to subsessile flowers, parietal placentation, a mostly shrubby or subshrubby habit and perennial duration, and distribution from northern Baja California to southern Oregon. All are at diploid level,  $n = 10$ . This group has sometimes been treated at generic rank (as *Diplacus* Nutt.) but recent molecular-phylogenetic studies (Beardsley et al. 2004) indicate that they are derived from species of annual duration and nested within the cladistic topology of a more broadly conceived *Diplacus* — they are appropriately regarded as sect. *Diplacus*. Formal nomenclature for the whole genus and rationale for its separation from *Mimulus* L. sensu stricto are presented by Barker et al. (2012). Thompson (2005) treated the whole group (*Diplacus*, including sect. *Diplacus*) as *Mimulus* subg. *Schizoplagus* A.L. Grant.

The taxonomy of sect. *Diplacus* at species and infraspecific rank has been controversial. McMinn (1951a) retained the group at generic rank and recognized fourteen species. Beeks (1962) had similar concepts of species, noting that they were distinct morphologically and ecologically. At another extreme, Thompson (1993, 2005, 2012) has recognized only two species (as *Mimulus clevelandii* and *M. aurantiacus*, monotypic and with 6 infraspecific taxa, respectively), emphasizing high crossability of all taxa and perceived hybridization and intergradation. The present account, which recognizes thirteen species or species-like entities (three of them may be hybrid in origin), is closer in concept to those of McMinn and Beeks, as well as to those of Grant (1924), Pennell (1951), and Munz (1973, 1974), who treated the species within *Mimulus*.

The first author of the present account studied sect. *Diplacus* (Tulig 2000; Tulig & Clark 2000; using nomenclature within *Mimulus*, modified here to *Diplacus*), using 953 plants sampled from 155 locations in California (Fig. 1; see Tulig 2000 for precise localities) chosen to represent the essential geographic range of all named taxa (except for *D. stellatus* from Baja California). A fuller extent of populations representing sect. *Diplacus* is shown by Thompson (2005), although some taxa recognized here are not shown by him as separate entities, and by McMinn (1951a). Plant

identification was based primarily on the keys of Munz (1973), with additional reference to McMinn (1951a) and specimens at RSA. Measurements of floral and foliar characters using digital calipers were made on the uppermost mature flower and subtending leaf of a randomly chosen branch. Three flowers per plant were measured during the 1999 season to address within-plant variation, and one flower per plant was measured during the 2000 season. Vouchers of populations are deposited at RSA and pressed specimens of each plant sampled are at CSPU.

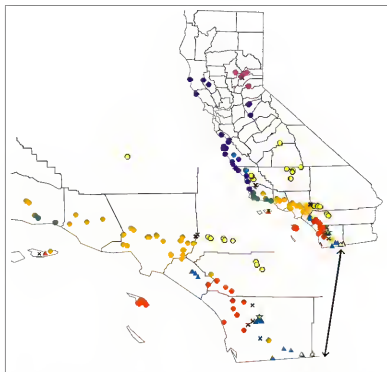


Figure 1. Location of collection sites for the 1999 and 2000 field seasons (Tulig 2000). Dark purple circles—*D. aurantiacus*, light blue circles—*D. x lineans*, purple circles—*D. grandiflorus*, green circles—*D. x lempocensis*, orange circles—*D. longiflorus*, red circles—*D. pusillus*, red triangles—*D. parviflorus*, yellow circles—*D. calycinus*, blue triangles—*D. x australis*, yellow triangles—*D. aridus*, green star—*D. clevelandii*, black X—hybrid or undetermined population. Also see Figs. 4 and 5.

Data were analyzed by principal components analysis (Fig. 2) and discriminant function analysis (Fig. 3). Both analyses distinguished four major groups: (1) *Diplacus clevelandii*, (2) *D. aridus*, (3) taxa with large corollas — *D. grandiflorus*, *D. longiflorus*, and *D. calycinus*, and (4) taxa

with relatively small corollas — *D. purpureus*, *D. parviflorus*, and *D. aurantiacus*. Within each group, geographic ranges further distinguish the taxa and clear separations can be made between most taxa based on quantitative and qualitative morphological characters. *Diplacus stellatus* is an endemic of Cedros Island in Baja California, Mexico, and was not included in the Tulig studies but is included here in the fourth group on the basis of morphology — Thompson (2005) treated *D. stellatus* as a synonym of *Mimulus aurantiacus* var. *auranticus*.

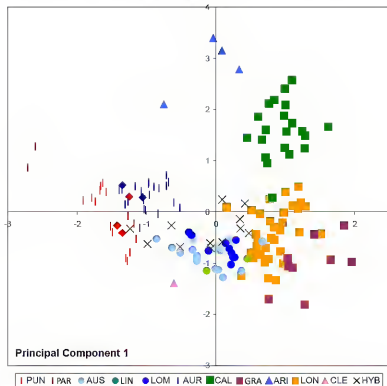


Figure 2. Plot of first two principal components of population means, representing 75.8% of the variation. HYB refers to populations that could not be assigned to a single taxon.

The first three principal components (PCs) account for 85.8% of the total variance of the data (59.6, 16.2, and 9.7% respectively for PC1, PC2, and PC3). PC1 has the highest loadings for all of the corolla features, especially "length across bottom lobes," "apex of upper corolla lobe to outer sinus," and "opening of throat," and high negative loadings for filament lengths. PC2 has the highest loadings for corolla tube length, calyx measurements, and style length and high negative loadings for numerous corolla features. PC3 has the highest loadings for filament lengths and style length.

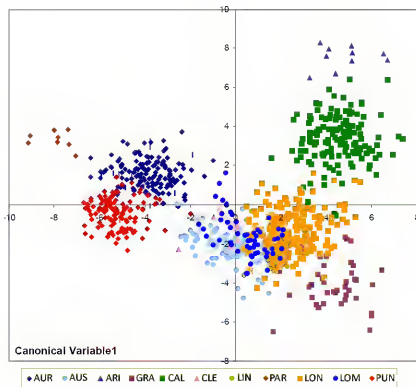


Figure 3. Plot of first two canonical variables of individual plants from the discriminant function analysis.

The first three canonical variables (CVs) account for 90.9% of the variance of the data (64.1, 22.6, and 6.9% respectively). Corolla tube length accounts for most of the variation in CV1 separating the same small and large flowered groups as in the PCA. Corolla tube length was also high on CV2, as well as the corolla features "width of lower center lobe" and "opening of throat," and calyx height. Characters loading highest on CV3 were both calyx features and style length. The scatter plot of the first two canonical variables is similar to that of the PCA except for the position of *M. aridus* which is placed high on both CV1 and CV2 because of its long corolla tube length.

#### Species concepts and hybridization in sect. *Diplacus*

In discussing the rationale for his taxonomic concepts regarding sect. *Diplacus*, Thompson (2005, p. 150), noted this: "*Mimulus aurantiacus* shows the most complex variation patterns found in subg. *Schizoplacus*, hybridization occurs wherever any two varieties come together. I have attempted to summarize some of these patterns with as much detail as possible on the distribution maps (Figs. 63-65). A large proportion of specimens are intermediate to some degree and some of these may not



easily key to a recognized variety. Hybrids seem to be sufficiently fertile to allow considerable backcrossing to occur within each hybrid zone, commonly resulting in a complete range of intermediates. The hybrid intermediates have no distinguishing features of their own and very few characters separate the varieties. None of the varieties are geographically isolated from the others, and all have produced naturally occurring intermediates with at least one other variety. I have therefore chosen to accommodate the minimal diversity of this complex among varieties, rather than among species."

In addition to Thompson's view of the variation patterns, he emphasized practical aspects of producing a classification (p. 25). "The intermediates recognized in this work (which often show highly variable or clinal morphological variation between the putative parents) are geographically where we would expect them to be; recognizing them as intermediates or hybrids, rather than as new taxa, increases our understanding of this group and strengthens the classification by making the keys and descriptions work easily for the vast majority of material. The intermediates have very few, if any, unique characteristics, a situation that would cause serious difficulties in writing keys and descriptions, if they were to be recognized as distinct taxa. I must embrace a practical morphological species concept, if this monograph is to be favorably received."

In accounting for his divergence earlier taxonomic concepts (presumably alluding to Munz and others), Thompson observed that earlier studies were "based on little or no original work beyond that provided by Grant (1925)." He did credit McMinn, however, with original work but noted (p. 3) that "unfortunately, the distribution maps provided in McMinn's paper did not show adequately the intricate patterns of hybridization and introgression linking most of the taxa; the same is true of the maps in later work by Beeks (1962)." Thompson also pointed out an ambiguity in McMinn's application of species concept that appears to have linked their two treatments.

McMinn (1951a, p. 34) observed the following: "I have chosen to treat all these field entities (taxa) simply as binomials. Inasmuch as binomials to most botanists indicate species, I have endeavored not to use the word species when writing of these various entities. I must point out, however, that if sterility and geographical distribution tests were the main criteria applied in delimiting species and subspecies, then the field entities of the genus *Diplacus* probably would be classified as two taxonomic species [*D. aurantiacus* and *D. clevelandii*], eleven subspecies, and numerous hybrids." Except for this caveat, however, he treated 14 taxa exactly in the format of species, even describing "4. *Diplacus lomdocensis* sp. nov." — thus it appears that McMinn (1951a and also in 1951b) was not satisfied with simply "sterility and geographical distribution tests" in his working and practical concept of *Diplacus* species.

The studies of Tulig, which were not cited or alluded to by Thompson, conclude with a different perspective, more similar (in recognizing more than two species) to those of previous students of the group. Each of the taxa of sect. *Diplacus* has a distinct geographic range and for the most part is clearly defined (Fig. 4), and throughout most of the range of sect. *Diplacus*, hybridization appears to be limited. Much of the taxonomic confusion in the group can be attributed to introgression and hybridization in southern California, occurring mostly at the overlap in distribution of *D. aurantiacus*, *D. puniceus*, *D. australis*, *D. longiflorus*, and *D. calycinus* (Fig. 5). These hybrid/introgressive populations are often characterized by a wide range of corolla colors within and between plants and floral features intermediate to their putative parents.

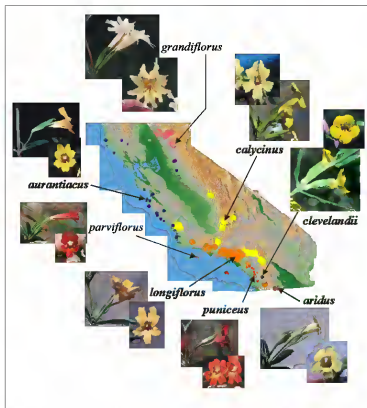


Figure 4. Geographic distribution of *Diplacus* species in California (representing populations studied by Tulig, see Fig. 1). *Diplacus rudius* is not included in Figure 4 but is treated here as distinct

Sect. *Diplacus* is well adapted to dry environments and rock crevices, and the expansion of roads into inner mountain regions has increased the frequency of hybridization. Hybrid populations are repeatedly found along road cuts, as noted here and by others (McMinn 1951a, Beeks 1963, Waayers 1996) and in some areas, hybrids seem to be restricted to road cuts, where they frequently have been collected. The view here emphasizes that blurred boundaries between species have arisen in large part because of zones of sympatry created by human disturbance. The entities are recognized as morphologically distinct and with distinct geographic ranges and as producing intermediates through hybridization only in relatively narrow boundary regions.

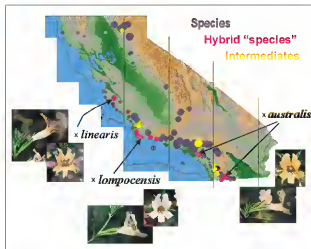


Figure 5 Geographic distribution of *Diplacus* hybrids in California (representing populations studied by Tulig, see Fig. 1)

In the analyses of Tulig (2000), in addition to the entities interpreted as species, three others were consistently distinguished: *Diplacus lompocensis* (*Mimulus aurantiacus* var. *lompocensis*), *Diplacus australis* (*Mimulus aurantiacus* var. *australis*), and *D. linearis* (*Mimulus bifidus* subsp. *fasciculatus*). Each of these appears to be of hybrid origin and is formally treated below. *Diplacus*  $\times$  *lompocensis* and *D.*  $\times$  *australis* are intermediate between the large-flowered taxa and small-flowered taxa; *D. linearis* is more similar to the large-flowered taxa.

McMinn recognized essentially the same species as here but included as species those treated here as hybrids — *D. lompocensis*, *D. australis*, and *D. linearis* (as well as *D. fasciculatus* as a distinct entity). He also recognized *D. rubric* as distinct — it is tentatively placed here within *D. longiflorus* (see comments below). His study included intensive field- and herbarium- and garden study as well as a broad range of artificial crosses.

Beeks (1962) studied only mainland species of southern California, recognizing *Diplacus aridus*, *D. clevelandii*, *D. calycinus*, *D. longiflorus*, and *D. pauciflorus*. Judging from his species concept, he probably also would have recognized species generally consistent with the taxonomy of McMinn and Tulig. He noted (p. 130) that "When compared regionally, populations of uniform *Diplacus* exhibit conspicuous discontinuities that justifiably allow their recognition as taxonomic units. The breakdown of ecological isolation and the occurrence of introgressive hybridization are

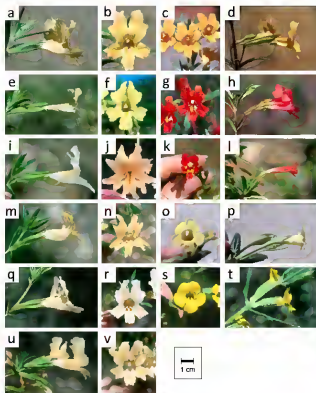


Figure 6. *Diplacus* flowers in face and side view. a, b *D. longiflorus*; c, d *D. aurantiacus*; e, f *D. calycinus*; g, h *D. puniceus*; i, j *D. grandiflorus*; k, l *D. parviflorus*; m, n *D. x linearis*; o, p *D. aridus*; q, r *D. x longipetens*; s, t *D. cleveandii*; u, v *D. x australis*. *Diplacus rutulus* is not included.

important causes of populational variability. Interspecific hybridization along the zone of species contact is followed by introgression into the populations. Ecologically open habitats allow extreme recombinants to succeed."

### Differences in coadapted pollination systems

In a study of floral isolation between ornithophilous and sphingophilous species, Verne Grant (1993) recognized eight species of *Diplacus* — *D. parviflorus*, *D. puniceus*, *D. longiflorus*, and *D. aurantiacus* are hummingbird-pollinated, while *D. calycinus* and *D. aridus* are hawkmoth-pollinated. *Diplacus clevelandii*, which he interpreted as the most primitive member of the group, is bee-pollinated. He did not have information about *D. stellatus* or *D. grandiflorus*, but the latter appears to be hawkmoth-pollinated, based on its morphology (many good photos available on the internet). *Diplacus stellatus* is closely similar to *D. aurantiacus* and perhaps also is hummingbird-pollinated.

The ornithophilous flowers have red to orangish corollas, daytime nectar production, and relatively shorter and broader corolla tubes (corresponding to hummingbird mouthparts). The sphingophilous flowers have pale-colored corollas, vespertine and nocturnal nectar production, and long and narrow floral tubes (suitable for a long slender proboscis) (Fig. 6). The flowers are structurally adapted for one or the other pollinator type, and foraging behavior of the pollinators is correspondingly adjusted to recognize the interspecific floral differences.

Hummingbirds, however, sometimes visit sphingophilous flowers, hawkmoths sometimes visit ornithophilous flowers, and bees often visit both types of flowers. Thus, secondary pollinators may cross-pollinate the contrasting species, and hybrids and hybrid populations have flowers of intermediate structure that can be visited and pollinated successfully by both hummingbirds and hawkmoths.

The ornithophilous taxa of *Diplacus* are, among themselves, mostly allopatric, as also are the sphingophilous taxa, and Grant surmised that the species of each group arose through allopatric speciation that includes a stage of geographical isolation. "It seems likely that the ancestral species in each plant group developed an ornithophilous pollination race in one geographical area that was favorable for hummingbird pollination and a sphingophilous pollination race in another geographically isolated area that was favorable for sphingophily. Continued divergence with respect to pollination and secular ecological conditions led the divergent branches to the level of externally isolated species, and range expansions brought about sympatric overlap" (Grant 1993, p. 7732).

Streisfeld and Kohn (2005, 2006) studied pollination of *Diplacus* in San Diego County and concluded, in contrast to Grant, at least in this instance, that selection may have caused divergence in flower color in the absence of geographic barriers to gene flow. They found a sharp geographic transition between the coastal red-flowered plants (*D. puniceus*) and the inland yellow-orange-flowered plants (identified here as *D. longiflorus*, see detailed comments below, but by Streisfeld and Kohn as *D. x australis*), with a narrow zone of transition (ca. 20 kilometers wide) at their parapatric boundary. The inland and coastal plants also are distinct in corolla tube length and width and volume of nectar production, but corolla color is the most highly divergent feature. Yellow-flowered plants are absent from the western (coastal) region and red-flowered plants are absent from the eastern side of the cline. Pure phenotypes occur in the transition area but intermediate flower colors through hybridization occur there and not elsewhere.

In contrast, however, to the sharp differentiation in corolla color between *Diplacus puniceus* and *D. x longiflorus*, genetic differentiation between the two entities at neutral marker loci is far less pronounced — consistent with the hypothesis that current or recent natural selection maintains the steep cline in flower color despite gene flow (Streisfeld & Kohn 2005). The apparent weak neutral

divergence argues against recent secondary contact after a long period of allopatry. Still, in a significant caveat, (p. 2558), they allowed that "Grant's (1993b) contention that red and yellow floral races of *M. aurantiacus* diverged in allopatry may still be accurate, but either the time in allopatry was too short for much neutral divergence to arise, or secondary contact is old, and the cline in flower color has been maintained after secondary contact by selection."

### Conservation implications

Recognition of the morphological geographical boundaries of evolutionary entities and the rank at which the taxa are treated are significant in conservation of this group. The only species currently listed as rare by the California Native Plant Society (2012) are *Diplacus aridus* and *D. parviflorus* (and at species rank, in contrast to Thompson's taxonomy) and *D. clevelandii*. *Diplacus aridus* is ecologically distinct and has a limited distribution in San Diego county and northern Baja California. *Diplacus parviflorus* is restricted to the Channel Islands, where ecosystems have been heavily damaged by feral animals.

Plants of sect. *Diplacus* are widely and relatively easily cultivated. Accurate identifications plants already in cultivation will be significant and also may better inform appropriate plantings for species needing attention for conservation.

### DIPLACUS sect. DIPLACUS

*Diplacus* Nutt., Ann. Nat. Hist. 1: 137. Apr 1838. *Mimulus* sect. *Diplacus* (Nutt.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876. **LECTOTYPE SPECIES** (Thompson 2005, p. 25): *Diplacus glutinosus* (Wendland) Nutt. = *Diplacus aurantiacus* (Curtis) Jeps.

In the nomenclatural citations below, distribution of types is mostly according to McMinn (1951a) and Thompson (2005). A few types (depositions) have been added and all confirmations of observation (e.g., "digital image!") are from the present study.

### KEY TO THE SPECIES

1 Rhizomatous subshrubs, stems basally woody, distally herbaceous; plants villous-glandular; leaf blades irregularly dentate, finely pubescent-glandular on both surfaces, corollas deep yellow, lobes all about equally joined; capsules 9–12 mm **1 *Diplacus clevelandii***

1 Taprooted shrubs, stems extensively woody, plants glutinous, often with evident stipitate-glandular hairs; leaf blades dentate to entire, not glandular-pubescent on upper surface, corollas red to pale yellow or orange, upper lobes united 1/3–1/2 their length; capsules 12–25 mm

2 Corollas red to scarlet, throats nearly cylindric and decurved, stigmas and anthers of the longer filaments exerted

3 Calyces villous to hirsute-villous **11 *Diplacus rutilus***  
3 Calyces glabrous

4 Leaf blades ovate-oblong, apically rounded; corollas strongly decurved, lobes subequal, only slightly if at all notched, Channel Islands **8 *Diplacus parviflorus***

4 Leaf blades linear-lanceolate, apically acute, corollas slightly decurved, lobes unequal and notched, mainland **9 *Diplacus puniceus***

2 Corollas yellow to salmon-colored or orange, throats campanulate, straight to slightly curved, anthers and usually the stigmas included

5 Calyces 35–40 mm at maturity, tubes distinctly broadened-inflated distally, corolla throats broadly campanulate, ca. half as long as the narrow tube; plants mostly 2–4 dm **2 *Diplacus aridus***

5. Calyces 20–30 mm at maturity, tubes only slightly broadened distally; corolla throats narrowly campanulate, ca. as long as the narrow tube, plants mostly 4–30 dm.

6. Upper corolla lobes deeply notched and appearing bilobed.

7. Leaf blades elliptic-oblong, 8–15 mm wide, apically obtuse to rounded, glabrous abaxially, corolla tube-throat 50–65 mm, lobes notched 1/4–1/2 their depth, central Sierra Nevada

5 ***Diplacus grandiflorus***

7. Leaf blades linear-lanceolate, 3–5 mm wide, apically acute, stellate-pubescent to glabrous abaxially; corolla tube-throat mostly 45–55 mm, lobes notched less than 1/4 their depth; coastal ranges

6 ***Diplacus x linearis***

6. Upper corolla lobes retuse or shallowly notched to entire or nearly so

8. Calyces villous to hirsute-villous, leaf blades abaxially villous with a mix of stellate hairs and relatively longer unbranched hairs.

9. Corollas cream to light yellow, tube-throat 48–55 mm; styles 38–46 mm 7 ***Diplacus calycinus***

9. Corollas salmon, tube-throat 40–48 mm, styles 28–37 mm 10 ***Diplacus longiflorus***

8. Calyces glandular-puberulent to glabrate or glabrous, leaf blades abaxially glabrous or stellate-pubescent, mostly without unbranched hairs

10. Corollas orange to orange-yellow, pedicels 3–17(–25) mm, leaves 7–11.5 mm wide

11. Pedicels 4–17(–25) mm, attached asymmetrically to calyx base (offset to one side); foliage not densely congested (internodes relatively elongate); southwestern Oregon to southwestern California

3 ***Diplacus aurantiacus***

11. Pedicels 3–5(–8) mm, attached symmetrically to calyx base; foliage densely congested (internodes relatively short); Cedros Island, Baja California

4 ***Diplacus stellatus***

10. Corollas pale yellow to orange-yellow or light orange, pedicels 4–6 mm, leaves 3.5–8 mm wide

12. Orange, Riverside, and San Diego cos. 12 ***Diplacus x australis***

12. Santa Barbara Co. and extreme s. San Luis Obispo Co. 13 ***Diplacus x lompopensis***

1. ***Diplacus clevelandii*** (Brandegee) Greene, *Erythra* 4: 22. 1896. *Mimulus clevelandii* Brandegee, Gard. & Forest 8: 134, plate 20. 1895. TYPE: USA. California. San Diego Co.: Cuyamaca Peak [protologue: "on the south side ... not far from the signal station on its summit. ... elevation over 6000 feet"], 7 Jul 1894, T.S. Brandegee s.n. (holotype: UC digital image!, photo PH; isotypes: DS digital image!, GH, POM, SD, US digital image!).

**Distribution.** Orange, Riverside, and San Diego cos.; Baja California.

2. ***Diplacus aridus*** Abrams, Bull. Torrey Bot. Club 32: 540. 1905. *Mimulus aridus* (Abrams) A.L. Grant, Ann. Missouri Bot. Gard. 11: 336. 1924. TYPE: USA. California. San Diego Co.: dry ridges, Jacumba, near the monument, 31 May 1903, L. Abrams 3656 (holotype: NY digital image!; isotypes: BM, CAS digital image!, E, F digital image!, GH 2 sheets, K, MO digital image!, NY digital image!, PH digital image!, POM, RSA, UC-2 sheets, US digital image!).

**Distribution.** Imperial and San Diego cos.; Baja California.

3. *Diplacus aurantiacus* (Curtis) Jeps., Man. Fl. Pl. Calif. 919. 1925. *Mimulus aurantiacus* Curtis, Bot. Mag. 10: plate 354. 1796 (not *M. aurantiacus* Renjifo; see Grant 1924, p. 146). *Diplacus glutinosus* var. *aurantiacus* (Curtis) Lindl., Paxt. Fl. Gard. 3: plate 92. 1851. **NEOTYPE** (Thompson 2005, p. 149): USA. California. "Hort. Kew, 1795, ex California," without collector or number (BM!, photo UC!). In selecting the neotype, Thompson noted this: "In the protologue Curtis does not describe or mention fruits or seeds and states 'flowered this Summer with Mr. Covill, Nurseryman, King's-Rd. [...]' We know not with certainty of what country it is a native." The neotype I have selected for *Mimulus aurantiacus* is appropriate, because it is cultivated material preserved in 1795. Even if it is not Covill's material and Curtis never saw this specimen, it probably came from the same wild-collected seed source as his material, given the difficulties of acquiring material from California at the time."

*Mimulus glutinosus* J.C. Wendland, Bot. Beob., 51. 1798. *Diplacus glutinosus* (J.C. Wendland) Nutt., Ann. Nat. Hist. 1: 138. 1838. **TYPE**: USA. California. According to Thompson (2005, p. 151), "a collection taken from cultivated material in the Wendland Herbarium, without collector or date (**neotype**: GOET, scanned image!)."

*Diplacus leptanthus* Nutt., Ann. Nat. Hist. 1: 138. Apr 1838, 'leptantha? [also: Bot. Mag. 65: plate 3655. 1 May 1838]. *Mimulus leptanthus* (Nutt.) A.L. Grant in L.H. Bailey, Gentes Herb. 1: 136. 1923. **TYPE**: USA. California. "herb. Schw. sub nom. 'M. glutinosus Mendoza-Hook.,' *Diplacus leptantha* Nutt.," [protologue: at PH; "communicated to the late Mr. Schweinitz by Sir William Jackson Hooker, and marked '*Mimulus glutinosus* from Mr. Menzies'"] (holotype: PH digital image!, photo UC). **Synonym** of *Diplacus aurantiacus*, fide Thompson (2005, p. 152); = *Mimulus linearis* Benth., fide Bentham (1868, p. 368); = *Mimulus longiflorus* var. *linearis*, fide Grant (1924, p. 334).

*Diplacus latifolius* Nutt., Ann. Nat. Hist. 1: 138. April 1838 [also Bot. Mag. 65: plate 3655. May 1838]. *Diplacus glutinosus* var. *latifolius* (Nutt.) Greene, Pittonia 2: 155. 1890. **TYPE**: USA. California. [Monterey Co.:] [protologue: "round Montersey [Monterey], Upper California, in April," [BM sheet]: "Santa Barbara," *T. Nuttall s.n.* (holotype: BM photo PH!; isotype: K).

**Distribution.** Oregon: Curry Co. California: Del Norte, Humboldt, Mendocino, Lake, Colusa, Sonoma, Napa, Yolo, Sacramento, Marin, Solano, Contra Costa, Alameda, San Francisco, San Mateo, Santa Cruz, Santa Clara, Monterey, Stanislaus, Merced, Eldorado, Amador, Calaveras, Tuolumne, San Luis Obispo, and Santa Barbara cos.

4. *Diplacus stellatus* Kellogg, Proc. Calif. Acad. Sci. 2: 18. 1863. *Diplacus glutinosus* var. *stellatus* (Kellogg) Greene, Pittonia 2: 155. 1890. *Mimulus stellatus* (Kellogg) A.L. Grant, Ann. Missouri Bot. Gard. 11: 337. 1924. **LECTOTYPE** (Thompson 2005, p. 152): MEXICO. Baja California. Cedros Island, *J.A. Veatch s.n.* (GH; isoelectotype: CAS). The holotype at CAS was destroyed.

**Distribution.** Baja California, known only from Cedros Island.

*Diplacus stellatus* is characterized by relatively small, orange-yellow corollas, nearly glabrous calyces, and short, nearly glabrous pedicels. McMinn distinguished it from *D. aurantiacus* in his key by corollas [limbs] less than 3/4 inch broad (vs. corollas 3/4 to 1 1/8 inches broad in *D. aurantiacus*). He noted that the epithet is a misnomer, as the stellate hairs on the abaxial leaf surfaces of the type specimen apparently are from other species, but the present study confirms the presence of stellate hairs in both *D. stellatus* and *D. aurantiacus*.



Thompson (2005) treated *Diplacus stellatus* simply as a synonym of *D. aurantiacus* var. *aurantiacus*, and morphological differences between them indeed are hardly pronounced. The far geographic disjunction of *D. stellatus*, however, and its proximity instead to other species suggests that similarities with *D. aurantiacus* may be convergent. The differences in internode and pedicels lengths and pedicel insertion (as in the key) provide a morphological basis for maintaining *D. aurantiacus* and *D. stellatus* as distinct.

5. *Diplacus grandiflorus* Greenland, Rev. Hort. [Paris] ser. 4, 6: 402, fig. 136. 1857 (not *Diplacus grandiflorus* Greene, 1890). *Diplacus longiflorus* var. *grandiflorus* (Greenland) Jepson, Man. Fl. Calif. 919. 1925. *Mimulus bifidus* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 168. 1947, nom. nov. (based on *D. grandiflorus* Greenland, blocked in *Mimulus* by *M. grandiflorus* Howell 1901 = *Erythranthe guttata*). NEOTYPE (Thompson 2005, p. 159): Hort. Muhlenpfordt, Hannover, G. Engelmann, 4 Jun 1857, collector not indicated (MO).

Thompson's choice of a neotype is justified and accompanied by the following comments (p. 161): "The protologue for *Diplacus grandiflorus* Greenland was published on 16 August 1857, according to printers notations (p. 389) for Vol. 6, No. 16 (pp. 389-416). The neotype I have selected for this name is dated 4 Jun 1857. The specimen seems to have come from Hannover, Germany, perhaps sent from Muehlenpfordt to Engelmann. Greenland mentions only unspecified cultivated material, and the neotype is cultivated material. Although there is no direct connection between this specimen and the protologue, it seems to be an appropriate neotype for Greenland's name. Even if Greenland never saw it, there is a good chance that it grew from the same seed source as his material, given the difficulties of acquiring seeds from California at that time."

Unfortunately, however, the origin of the cultivated plants represented by the specimen is likely to have been from Monterey Co. or San Luis Obispo Co., where various early collectors made visits — that is, the range of *Diplacus x linearis* (typified by a Douglas collection from a coastal locality in this area). If this can be shown to be the case, then *D. grandiflorus* Greenland would be recognized as a synonym of *D. x linearis* and the Sierran species would be without a name.

*Diplacus glutinosus* var. *grandiflorus* Lindl. & Paxton, Paxt. Fl. Gard. 3: 96, plate 92. 1852. *Mimulus aurantiacus* var. *grandiflorus* (Lindl. & Paxton) D.M. Thompson, Monogr. Syst. Bot. 75: 158. 2005. NEOTYPE (Thompson 2005, p. 158): USA. California. Butte Co.: Between Chico and Forest Ranch, elev. 2000 ft., 18 May 1914, A.A. Heller 11407 (UC; isoneotypes: A, CAS, CU, DS, E, F, GH, MO, ND-G, NY, OSC, PENN, PH).

*Diplacus grandiflorus* Greene, Pittonia 2: 156. 1890, nom. illeg. (not *Diplacus grandiflorus* Greenland 1857). LECTOTYPE (Thompson 2005, p. 159): USA. California. [Nevada Co.]: On Yuba River, 5 Jul 1884, E.L. Greene s.n. (ND-G-1714; isoclectotype: ND-G-1721). A photo of one or the other of the ND-G sheets is at PH!

Distribution. Tehama, Butte, Plumas, Yuba, Sierra, Nevada, El Dorado, and Placer cos.

6. *Diplacus x linearis* (Benth.) Greene, Pittonia 2: 156. 1890. *Mimulus linearis* Benth., Scroph. Ind. 27. 1835 (as species). *Mimulus glutinosus* var. *linearis* (Benth.) A. Gray, Proc. Amer. Acad. Arts 11: 97. 1876. *Mimulus glutinosus* forma *linearis* (Benth.) Voss in Vilmorin, Vilm. Blumengarten. (ed. 3) 1: 762. 1895. *Mimulus longiflorus* var. *linearis* (Benth.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 334. 1924. *Diplacus longiflorus* var. *linearis* (Benth.) McMinn, Man. Calif. shrubs (ed. 1) 498. 1939. TYPE: USA. California. No other collection data, Douglas s.n. (holotype: K-herb. Benth.; isotypes: BM, E, GH, K-herb. Hooker, NY digital image, OXF). Douglas's itinerary in 1832 included localities in Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara counties.

*Mimulus bifidus* subsp. *fasciculatus* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 168. 1947. *Diplacus fasciculatus* (Pennell) McMinn, Madroño 11: 70, 73. 1951. TYPE: USA. California: Monterey Co.: Rocky hills, Santa Lucia Park, Arroyo Seco, alt. 2500 ft, 10 May 1936, L.S. Rose 36278 (holotype: PH; isotype: US).

Distribution. Monterey, San Benito, and San Luis Obispo cos.

These plants were allied by Pennell (1947, p. 168) with the Sierran *Diplacus grandiflorus* Groenland (= *Mimulus bifidus* Pennell), as "a narrower-leaved and smaller-flowered subspecies," and they were considered synonymous by Thompson (2005), but the two are disjunct in geography (Figs. 3 and 4) and ecology. The molecular analysis by Beardsley et al. (2004) suggests that *D. grandiflorus* is related as a sister to *D. aurantiacus*.

*Diplacus grandiflorus* and *D. x linearis* appear to be distinct as a pair particularly in the notching of the upper corolla lobes, but morphology and geography suggest that the parents of *Diplacus x linearis* are *D. calycinus* and *D. aurantiacus*, thus *D. grandiflorus* and *D. x linearis* are not each other's closest relatives. McMinn (1951a) regarded *Diplacus x linearis* as a hybrid between *D. aurantiacus* and *D. fasciculatus*, the latter treated by him as a distinct species and separate from the Sierran *D. grandiflorus*.

7. *Diplacus calycinus* Eastw., Bot. Gaz. (Crawfordsville) 41: 287. 1906. *Mimulus longiflorus* var. *calycinus* (Eastw.) A.L. Grant, Ann. Missouri Bot. Gard. 11: 331. 1924. *Diplacus longiflorus* var. *calycinus* (Eastw.) Jeps., Man. Fl. Pl. Calif. 919. 1925. *Mimulus longiflorus* (subsp. *calycinus* (Eastw.) Munz, Aliso 4: 99. 1958. TYPE: USA. California. Tulare Co.: South Fork Kaweah River, 6000 ft, 22 Jul 1904, G.N. Culbertson 4407 [distributed by C.F. Baker, No. 4407] (holotype: CAS digital image!; isotypes: CAS digital image!, GH, K, MO digital image!, NY digital image!, PH digital image!, POM, UC, US digital image!).

Distribution. San Luis Obispo, Los Angeles, San Bernardino, and Riverside cos., separated from a Sierran population system in Fresno, Tulare, and Kern cos.

Although first described as a separate species, *Diplacus calycinus* has more recently been treated at subspecific or varietal rank within *D. longiflorus* (Grant 1924; Pennell 1951; Munz 1973). Thompson (2005) went even further in including *D. calycinus* simply as a synonym within his concept of *Mimulus aurantiacus* var. *pubescens* (= *D. longiflorus*), but results from the Tulig PCA and DFA indicate that *D. calycinus* is distinct from *D. longiflorus*, especially in corolla length, corolla tube length, and style length. Corolla color is cream to pale yellow in *D. calycinus* and salmon in *D. longiflorus*.

*Diplacus calycinus* and *D. longiflorus* are essentially allopatric to parapatric. Particularly in Fresno, Tulare, and Kern cos., where *D. calycinus* occurs completely separated from *D. longiflorus* (see Thompson's Fig. 63), it appears to be clearly distinct especially in abaxial leaf vestiture — the hairs are unbranched, broad, and vitreous, compared to the branched, thinner, and dull hairs of *D. longiflorus*. The type of *D. calycinus* is a Sierran plant from Tulare County.

Overlap between the two taxa occurs only in southern California, especially in the region (in San Bernardino Co.) connecting the San Gabriel and San Bernardino mountains. In that area, flower color of individuals of *D. calycinus* ranges from light to dark orange, and corolla length is shorter.

10. *Diplacus longiflorus* Nutt., Ann. Nat. Hist. 1: 139. 1838. *Mimulus longiflorus* (Nutt.) A.L. Grant, Gentes Herb. 1: 136. 1923. TYPE: USA. California. [Santa Barbara Co.]: [protologue]: "in rocky places by small streams, in the vicinity of Sta. Barbara." Apr [1836], T. Nuttall s.n. (holotype: BM photo PH!; isotypes: GH, K). Noted by Nuttall as "A species remarkable for the width and very oblique emargination of the lobes of the corolla, which is of a paler yellow than in any other species, and inclining to a fawn color. The stems are very leafy, pubescent, and the leaves elongated and acuminate. The base of the calyx is also almost lanuginous."

*Diplacus glutinosus* var. *pubescens* Torrey, Pacif. Railr. Rep. 7(3): 15. 1857. *Mimulus aurantiacus* var. *pubescens* (Torrey) D.M. Thompson, Syst. Bot. Monogr. 75: 161. 2005. TYPE: USA. California. Lieut. Parke's Expedition, between San Bernardino and San Diego, Apr 1854-55, Dr. Antisell 176 (holotype: NY digital image!).

*Mimulus glutinosus* var. *brachypus* A. Gray in W.H. Brewer, S. Watson, & A. Gray, Bot. California 1 (ed. 1): 566. 1876. LECTOTYPE (Thompson 2005, p. 162): USA. California. "California," J.N. Coulter 639 (GH; isolecotypes: E, K-2 sheets).

*Diplacus arachnoideus* Greene, Calif. Acad. Sci. 1: 210. 1885. LECTOTYPE (Thompson 2005, p. 000): MEXICO. Baja California. All Saints' Bay [Bahia de Todos Santos], 16 Apr 1885, E.L. Greene s.n. (UC digital image!; isolecotypes: BM, GH, ND-G photo PH!). The holotype at CAS was destroyed.

*Diplacus speciosus* Davy, Erythra 2: 101. 1894. TYPE: USA. California. Cultivated at Berkeley ["Botanic Garden of the University of California"], Jun 1894, J. Burt Davy s.n. (holotype: UC digital image!; isotypes: ND-G, US digital image!). According to the protologue, the plants originally came from Humboldt County, but the loosely villous calyx vestiture indicates, in contrast, that its origin was much further south.

Distribution. San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Bernardino, Riverside, San Diego cos.; Baja California. Plants cited and mapped as *Mimulus aurantiacus* var. *pubescens* by Thompson (2005) from Fresno, Tulare, and Kern cos. are identified here as *Diplacus calycinus* (see comments above).

11. *Diplacus rutilus* (A.L. Grant) McMinn, Madroño 11: 83. 1951. *Mimulus longiflorus* var. *rutulus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 333. 1924. *Diplacus longiflorus* var. *rutulus* (A.L. Grant) McMinn, Man. Calif. Shrubs, 498. 1939. TYPE: USA. California. Ventura Co.: Santa Susanna Pass, dry hillsides, 10 Jun 1920, A.L. Grant 1650 (holotype: MO digital image!; isotypes: CAS, CU, GH, JEPS, K, NY-2 sheets digital images!, OSC, PH, POM, UC, US digital image!).

Distribution. Ventura, Los Angeles, and Riverside cos.

*Diplacus rutilus* was treated by McMinn (1951a) as a distinct species, one among three red-flowered species in the genus (corolla lobe margins tinged with yellow in *D. rutilus*). It was distinguished in his key by pedicels less than 3/8 inches long and glandular-hairy (vs. pedicels 3/8-1 inch long and glabrous in *D. puniceus* and *D. parviflorus*). He cited collections of *D. rutilus* from Ventura, Los Angeles, and Riverside counties. Beeks (1962, p. 120) noted that "the Santa Susanna Pass population in northeastern Ventura county ... with their deep velvety red flowers, are considered to constitute only a form of *D. longiflorus*." Munz 1973 treated these plants as a variety of *D. longiflorus*, noting that they occur "with the sp. particularly in interior Los Angeles Co., less so in Ventura and Riverside cos." Thompson (2005) described the corolla color of [*D.*] *longiflorus* as "pale yellow" but placed *D. rutilus* as a synonym of that species without comment.

*Diplacus rutilus* is similar to typical *D. longiflorus* with respect to quantitative characters but was located infrequently in the field by Tulig. Measurements of populations with these red variants were not treated with *M. longiflorus* as a whole in the statistical analyses. Here, however, we hypothesize that these plants, surely distinct also in biology from yellow-flowered *D. longiflorus* and with a coherent albeit limited geographical distribution, appear to be justifiably treated at specific rank. They obviously need urgently to be studied and evaluated from the perspective of conservation.

12. *Diplacus* x *australis* (McMinn ex Munz) Tulig, comb. nov. *Diplacus australis* McMinn, Madroño 11: 58, 60, plate 12. 1951 (as species), nom. illeg. (without Latin diagnosis). *Mimulus aurantiacus* subsp. *australis* McMinn ex Munz, Aliso 4: 98. 1958. *Diplacus aurantiacus* subsp. *australis* (McMinn ex Munz) Beeks ex Thorne, Aliso 9: 194. 1978. TYPE: USA. California: San Diego Co.: Descanso Grade, Jun 1906, K. Brandegee s.n. (holotype: UC digital image!). McMinn cited a type (as above) but gave no Latin diagnosis, as he explicitly intended the epithet "australis" to be a *nomen novum* for *Mimulus linearis* Benth. (and its combined forms, see below), which he noted had been misapplied to the plants he was now referring to as *D. australis*. Munz, in recognizing the lack of a Latin diagnosis, provided one of his own, but he (Munz), in turn, cited no type — crediting McMinn for the basionym and providing the full citation for McMinn's attempt to validate the name.

Distribution. Orange, Riverside, and San Diego cos.; Baja California.

The placement of *Diplacus* x *australis* among hybrid/intermediate populations in both the PCA and DFA indicate that it is likely of hybrid origin. It is similar to *D. longiflorus* in overall flower morphology, including color, and its geographic distribution in southern California between *D. longiflorus* and *D. puniceus* suggests that Thompson's hypothesis (2005) that those two are the parents is reasonable (*Mimulus aurantiacus* var. *pubescens* x *M. aurantiacus* var. *puniceus* in his taxonomy, or *M. longiflorus* x *M. puniceus*).

Beeks (1962) noted that there is a pubescent race (the "San Gabriel race") of *Diplacus longiflorus* and a glabrous race (the "San Diego race") — the latter is interpreted here as essentially *D. x australis*. Calyx, pedicel, cauline, and leaf vestiture of *D. x australis* varies from glabrous to sparsely puberulent or short-villous. Corollas tend to have a narrower tube and limb. On the other hand, corolla color is longiflorus-like in almost all of these variants, including most plants identified by Thompson as intermediate between *D. longiflorus* and *D. puniceus*. A very small percentage appear (from herbarium collections) to have intermediate color. Munz (1973) described the corolla color of "subsp. *australis*" as orange-yellow to light apricot or buff or white."

*Diplacus x australis* and *D. x lompocensis* can be generally separated from *D. longiflorus* by their smaller corolla features and by much-reduced calyx (and other) pubescence, but the two putative hybrids are similar to each other in most other features. There are no obvious qualitative morphological distinctions between the two putative hybrids and they are only easily separated by geographic range.

As discussed above, Streisfeld and Kohn (2005) found that in San Diego County, *Diplacus longiflorus* (as identified here) and *D. puniceus* are discrete in morphology and separate in geography, separated by a narrow zone of hybrids and putative introgressants, among which *D. x australis* is included.

In the Tulig studies, hybrid populations in San Diego Co. show intermediate features on PC1 between *puniceus* and *longiflorus*. They also show a range of flower color from the red of *puniceus* to the orange of *australis* with various shades in between. These results confirm the findings of Waayers (1996) and that a zone of introgression exists between the coastal and inland populations and are in agreement with those of Streisfeld and Kohn (2005).

Thompson's Figure 65 (p. 163), which maps 126 herbarium specimens of these plants in San Diego County, shows a much broader zone of intermediates with the few yellow-flowered non-intermediates restricted mostly to the eastern extremity of the range and identified as *Diplacus longiflorus* (*Mimulus aurantiacus* var. *pubescens* in Thompson's taxonomy). *Diplacus puniceus* is shown as distributed in a broad and relatively discrete band in the west (near-coastal), corresponding to the observations of Waayers, Tulig, and Streisfeld and Kohn.

The same pattern, however, does not appear to hold for *Diplacus puniceus* and *D. longiflorus* in Baja California, either as mapped by Thompson (Fig. 65) or as mapped in the present account (Fig. 7, based on collections from SD, ARIZ, and TEX). Instead, based on Thompson's criteria and using many SD specimens annotated by him, *D. puniceus*, *D. longiflorus*, and putative intermediates (*D. x australis*) appear to be broadly sympatric. Most of the putative intermediates have both corolla color and morphology similar to typical *D. longiflorus* — Thompson's assessments of intermediacy apparently were weighted toward reduction in leaf width and in vestiture.

Only two Baja California collections were encountered that have the vegetative and floral morphology of *Diplacus x australis* but with red or reddish corollas, clearly suggesting the genetic influence of *D. puniceus*: S of San Vicente, Pennell & Epling 25240 (SD) and 2 mi NW of San Antonio [32° 00' N, 116° 40.5' W], Moran 13954 (SD). Otherwise, collector's notes for specimens mapped here as *D. x australis* describe corolla color as salmon, salmon yellow, pale yellow, pale orange-yellow, light orange, and pale orange.

Among the most significant problems needing further study in sect. *Diplacus* is the degree of variability in vestiture in *D. longiflorus* as related to the definition of *D. x australis*. Are yellow-flowered plants with reduced vestiture more accurately regarded as populational variants of *D. longiflorus*?



Figure 7. Distribution of *Diplacus puniceus*, *D. x australis*, and *D. longiflorus* in Baja California.

13. *Diplacus* x *lompocensis* McMinn, Madroño 11: 62. 1951 (as species). *Mimulus aurantiacus* subsp. *lompocensis* (McMinn) Munz, Aliso 4: 99. 1958. TYPE: USA. California: Santa Barbara Co.: edge of open woods along Highway between Lompoc and Las Cruces, Santa Inez Mountains, 7 Jun 1949, H.E. McMinn 5601 (holotype: UC digital image!).

Distribution. Santa Barbara Co. and extreme southern San Luis Obispo Co. (see Thompson's Fig. 64, p. 160).

*Diplacus* x *lompocensis*, which occurs essentially between the geographic ranges of *D. aurantiacus* and *D. longiflorus* in southern Santa Barbara County, is perhaps the result of hybridization between these species (this also was Thompson's interpretation). It has intermediate floral features between these species on PC1. Stable populations of the putative hybrid are found throughout this region, although at either end of its distribution, populations may more closely resemble the nearer parent. Considering that both *D. aurantiacus* and *D. longiflorus* are morphologically consistent across broad regions, *D. x lompocensis* is perhaps best interpreted as a stable zone of introgression.

Although the origin of *Diplacus* x *lompocensis* is different, its difference from *D. x australis* is quantitative and much-overlapping, mostly in corolla features. The two are only easily separated by geographic range.

0. *Diplacus puniceus* Nutt., Ann. Nat. Hist. 1: 137. 1838. *Mimulus puniceus* (Nutt.) Steud., Nomencl. Bot. (ed. 2) 2: 150. 1841. *Diplacus glutinosus* var. *puniceus* (Nutt.) Benth. in DC., Prodr. 10: 368. 1846. *Mimulus glutinosus* var. *puniceus* (Nutt.) A. Gray, Bot. California 1: 566. 1876. *Mimulus aurantiacus* var. *puniceus* (Nutt.) D.M. Thompson, Syst. Bot. Monogr. 75: 156. 2005. TYPE: USA. California: San Diego Co.: St. Diego [San Diego, 1836], T. Nuttall s.n. (holotype: BM; isotypes: K, PH digital image!).

Distribution. Los Angeles, San Bernadino, Orange, Riverside, and San Diego cos.; Baja California. A red-flowered plant from Sierra Co., apparently from a natural habitat, annotated by D.M. Thompson as *Mimulus aurantiacus* var. *puniceus* needs to be studied further (28 May 1988, Pitzer, Morgan, & Soldan 903, UCR).

0. *Diplacus parviflorus* Greene, Pittonia 1: 36. 1887. *Mimulus parviflorus* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 344. 1925 (not *Mimulus parviflorus* Lindley 1825). *Mimulus aurantiacus* var. *parviflorus* (Greene) D.M. Thompson, Syst. Bot. Monogr. 75: 157. 2005. *Mimulus flemingii* Munz, Man. S. Calif. Bot., 477, 601. 1935, nom. nov. (blocked by *Mimulus parviflorus* Lindley). LECTOTYPE (Thompson 2005, p. 157): USA. California. Santa Barbara Co.: [protologue: "north side of] Santa Cruz Island, Jul and Aug, 1886, E.L. Greene s.n. (UC digital image!; isoelectotypes: A, BM, DS digital image!, F digital image!, possible type GH, MO, ND-G-2 sheets, NY-3 sheets digital images!, PENN, PH digital image!, UC-2 sheets digital images!, US).

Distribution. (Channel Islands) in Santa Barbara, Ventura, and Los Angeles cos.

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## PLESIOGAMY, A TERM CONTRASTING WITH HERKOGAMY

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### ABSTRACT

Plesiogamy is proposed for use as the term referring to a close positioning of stigma and anthers, which usually leads to autogamy. Herkogamy, the contrasting term, refers to a spatial separation of the stigma and anthers, thus increasing the likelihood of outcrossing.

**KEY WORDS:** herkogamy and allogamy, plesiogamy and autogamy, dichogamy, synchronogamy

**Herkogamy** (Greek, *herkos*, wall or fence, and *gamos*, marriage; Brown 1956) refers to a spatial separation of the stigma and anthers, thus increasing the likelihood of outcrossing and production of genetically variable offspring. In "approach herkogamy," the most common form of herkogamy, the stigma is above the level of the anthers; in "reverse herkogamy" the stigma is below the anthers.

No term appears to exist, however, in reference to the contrasting situation, where stamens and stigma of a single flower are at the same level, in essentially the same position, thus making it likely that self-pollination occurs. The term **plesiogamy** (Greek, *plestos*, near, alluding to the proximity of the stamens and stigma) is proposed here for this arrangement and is used in several studies dealing with the taxonomy of *Mimulus* sensu lato (e.g., Nesom 2012). Plesiomorphic refers to an unspecialized condition (in contrast to plesiogamy, which usually is interpreted as a specialization), but the word itself (Greek, *plestos*, near, *morphe*, form) intends to convey the sense of nearness to the original morphological form, i.e., primitive.

Perhaps "non-herkogamy" would serve just as well as a contrasting term to herkogamy, but a positive term (vs. one that simply negates the opposing condition) seems useful. We prefer electron to "non-proton," past to "non-future," yang to "non-yin," etc, and the contrasting autogamy/allogamy and chasmogamy/cleistogamy have long been in use.

**Autogamy** (self-pollination, from anthers to stigma of a single individual, commonly within the same flower) is the mode implied by plesiogamous arrangement of anthers and stigma. **Allogamy** (cross-pollination, pollination between flowers of different individuals; synonyms or near-synonyms exogamy, xenogamy) is the usual mode of pollination and fertilization implied by herkogamous arrangement of anthers and stigma.

**Dichogamy** (in plants) refers to a temporal separation of pollen shedding and stigma receptivity. Protandry and protogyny describe conditions when anthers or stigmas mature first. Apparently no contrasting term exists for dichogamy, and it's suggested that, if necessary or desirable, **synchronogamy** (Greek, *syn*, same or together, *chronos*, time) could be used to indicate that pollen shedding and stigma receptivity occur simultaneously.

To complete the brief survey of opposing "-gamy" terms, **chasmogamy** refers to the condition in which corollas are open at anthesis, exposing the anthers and stigma and usually leading

to outcrossing. **Cleistogamy** refers to corollas that are closed at anthesis, strongly correlated with self-pollination.

**Geitonogamy** (Greek, *geiton*, neighbor) is another related term. It refers to the pollination — by insects or by wind — of a flower with the pollen from another flower on the same plant. The result of geitonogamy is genetically similar to autogamy.

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### THREE VARIETIES RAISED TO SPECIFIC RANK IN *DIPLACUS* (PHRYMACEAE)

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#### ABSTRACT

Two taxa treated as varieties by Thompson (2005) and one treated by him as a synonym are here elevated to specific rank: *Mimulus viscidus* var. *compactus* to ***Diplacus compactus*** (Thompson) Nesom, comb. et stat. nov., *Mimulus fremontii* var. *vandenbergensis* to ***Diplacus vandenbergensis*** (Thompson) Nesom, comb. et stat. nov., and *Mimulus bigelovii* var. *ovatus* to ***Diplacus ovatus*** (A. Gray) Nesom. The first two are endemic to California, the third endemic to Nevada. Attention is called to several other taxa recognized by Holmgren in 1984 (Intermountain Flora) as distinct species but later treated as synonyms by Thompson — *Mimulus spissus*, *Mimulus angustifolius*, *Mimulus densus*, and *Mimulus coccineus* — these apparently need further study.

**KEY WORDS:** *Mimulus*, *Diplacus*, California, species concepts

The study of *Mimulus* subg. *Schizoplacus* by David Thompson (2005) provides detailed descriptions, chromosome counts, distribution maps, typifications, illustrations, and discussions of variation in each taxon as well as morphological background for the whole group — in short a huge amount of useful information toward understanding the patterns of diversity in this group.

In preparation of the FNANM taxonomic treatment of subg. *Schizoplacus*, the group is recognized as the genus *Diplacus* Nutt. (Barker et al. 2012) and several divergences from the species-level taxonomy of Thompson are accounted for. First, thirteen taxa (vs. two) of sect. *Diplacus* at specific rank are recognized to occur in the USA (Tulig & Nesom 2012); second, in sect. *Eunamus*, two varieties named and described by Thompson and one variety described by Asa Gray are treated in the present account at specific rank. The greater number of species recognized in sect. *Diplacus* reflects differences in species concept as well as in perception and interpretation of variation patterns. In sect. *Eunamus* (the present account), varietal vs. species rank is mostly a matter of difference in species concept, as noted below.

**DIPLACUS COMPACTUS** (D.M. Thompson) Nesom, comb. et stat. nov. *Mimulus viscidus* var. *compactus* D.M. Thompson, Syst. Bot. Monogr. 75: 129. 2005. **TYPE:** USA. **California.** Fresno Co.: 4.2 mi E of Auberry (at Powerhouse Rd junction) along Auberry Rd, 950 m, abundant in openings among chaparral shrubs; often growing with *M. bolanderi* but more often growing alone; thousands of plants seen; corolla magenta, becoming dark red-purple in outer throat and adjacent limb, the throat floor ridges yellowish proximally but white at mouth, 12 May 1988, D.M. Thompson 891 (holotype: RSA digital image!; isotypes: BM, CHSC, E, F, FSC, HSC, JEPS digital image!, MO, NY, US). Distribution of types as cited by Thompson. Voucher for chromosome count of  $n = 8$ , from one plant.

Thompson noted that *Mimulus viscidus* var. *viscidus* and var. *compactus* have parapatric ranges, possibly intergrading (but not documented as so) in the vicinity of Mariposa in central Mariposa County, where the ranges are contiguous. "Both varieties have highly variable corolla markings, even within a single population. The two varieties are nevertheless easy to distinguish, even on most herbarium specimens, by the presence or absence of dark stripes on the corolla lobe

midveins. Plants of the two varieties remained distinctly different when grown together in the greenhouse."

The morphological differences, separate geographical ranges, and apparent lack of intergrading populations support recognition of these two taxa at specific rank. Perhaps Thompson viewed the degree of difference between his var. *viscidus* and var. *compactus* as smaller than that separating other closely related taxa held at specific rank, as he noted (p. 24) that "I have tried to hold the maximum level of morphological diversity among species, rather than among varieties in this difficult group." On the other hand, "The species concept used in this monograph is morphological and geographical. ... A species should be morphologically distinct from other species and intermediates must occur in geographical areas where we would expect hybrids to occur" — the latter concept appears to coincide with that used in the present account in justification of distinguishing the two taxa at species rank.

1. Corolla limb without radiating dark lines on lobes, although lobes may be dark at base, throat ceiling pubescent, limb glabrous on face, style glabrous or with sparse eglandular puberulence, lower stigma lobe 3–4 times longer than the upper, stems 2–28 cm, habit relatively condensed, nodes 2–3(–4), Fresno, Madera, Mariposa, and Tulare cos.

**Diplacus compactus**

1. Corolla with dark red-purple midveins on lobes, extending from throat, throat ceiling glabrous, limb usually pubescent on face, style glandular-puberulent, lower stigma lobe 1.5 times longer than upper, stems (3–)6–37 cm, habit relatively open, nodes 2–7, Amador, Calaveras, Eldorado, Mariposa, Merced, and Tuolumne cos

**Diplacus viscidus**

**DIPLACUS VANDENBERGENSIS** (D.M. Thompson) Nesom, comb. et stat. nov. *Mimulus fremontii* var. *vandenbergensis* D.M. Thompson, Syst. Bot. Monogr. 75: 134. 2005. TYPE: USA. California. Santa Barbara Co.: Burton Mesa, where the Casmalia Rd crosses Santa Lucia Canyon north of Lompoc, 250 ft, scattered annual, open sandy banks in sun with *Monardella*, to 9 in. tall, fls yellow, 15 Jun 1960, E.R. Blakley 3486 (holotype: JEPS; isotypes: CAS, RSA, SBBG). Distribution of types as cited by Thompson.

*Diplacus vandenbergensis* is endemic to Santa Barbara Co., mostly on the north side of the city of Lompoc (La Purisima Mission State Historic Park; on and near Vandenberg Air Force Base) plus one other locality about 10 kilometers further west (Santa Ynez Valley, 8 mi W of Buellton, sandy slope, 6 Jun 1931, R. Hoffman s.n., SBBG fide Consortium of California Herbaria 2012). Flowering Apr–Jun. Sandy open or disturbed areas among shrubs; 80–130 m; California.

Thompson (2005) described *Mimulus fremontii* var. *vandenbergensis* as a yellow-flowered variant (its existence earlier noted by Smith 1998) of the otherwise magenta-flowered *M. fremontii*. He summarized (p. 134) his taxonomic view of the variant as follows: "Red pigments seem to be absent from the flowers and leaves of [var. *vandenbergensis*], which occurs in a somewhat isolated area of Santa Barbara Co. where *M. fremontii* grows at the lowest point of its altitudinal range. Since yellow-flowered plants are not known from other parts of the range of this common species, it seems appropriate to recognize these populations as a variety. Aside from the lack of red pigments in their leaves and flowers, these plants are indistinguishable from plants of *M. fremontii* var. *fremontii* from adjoining regions."

Thompson also noted that "Yellow and magenta floral morphs are found in [*Diplacus mephiticus*, *D. parryi*, and *D. whitneyi*]. Both morphs are found through most of the geographic ranges of these taxa and the morphs are often found mixed together, although magenta morphs tend to predominate at higher altitudes. The two varieties of *M. fremontii* are different, however, for they have corolla colors that are unique to each, and they are geographically separated." *Diplacus*

*vandenbergensis* and *D. fremontii* may prove to have a sister relationship, but as in the rationale above for *D. compactus*, the discontinuous morphological difference, allopatric/parapatric geographical distribution, and lack of intergrading populations support recognition of the yellow-flowering plants at specific rank.

A series of photos and accompanying observations made by naturalist Don Tate in 2005 (CalPhotos 2012) at La Purisima Mission State Historic Park further support treatment of *Diplacus vandenbergensis* as specifically distinct. Tate noted that "Apparently, two varieties [of *D. fremontii*] grow in a very restricted area, but almost perfectly segregated by variety — populations separated by about 100 meters. ... To have two varieties segregated within that area suggests a LOT of ecological fine-tuning." "They both key out (Munz) to *Mimulus fremontii* due to short pedicels, 25 mm corollas (in yellow-only population, anyway) and glabrous anthers." "[The] Red variety is smaller in height, fewer-flowered and smaller-flowered than yellow. Most plants had dropped their corollas by June 3, while yellows were still in full bloom. [The red variety] grew on a ridgetop about 100 meters from yellow variety ... [and] there were a few yellow-flowered plants among the reds (under 10 percent). ... [The] Yellow variety was found on open, sandy slopes, below *Salvia* thickets (within about 6 meters). No red-flowered plants were found with them. Yellow-flowered plants were generally taller, with more flowers, and the flowers were distinctly larger than in red variety."

Two of the Tate photos (possibly of the same plant) are identified as var. *fremontii* presumably because of the magenta lobes, but they possibly show intermediate coloration — the corolla lobes are magenta while the tubes and throat are yellow to orangish with red mottling. Other CalPhoto images of *Diplacus fremontii* from various California localities show consistent corolla coloration. But even if the limited color variation at La Purisima Park reflects gene flow, the occurrence of hybridization does not suggest that the divergent population systems should be considered conspecific, since hybrids in *Mimulus* sensu lato are formed in many instances where closely related species occur together.

1. Corolla lobes, tube, and throat yellow; palate ridges with reddish-brown spots and mottling on the ridges and adjacent lateral areas; SW Santa Barbara Co ***Diplacus vandenbergensis***  
 1 Corolla lobes and tube magenta (or palate sometimes yellow in Baja California), throat completely dark purple or with broad, irregular, dark purple stripes; palate ridges yellow, sharply demarcated in color from magenta lateral areas; Monterey and San Benito cos., S to San Diego Co. (and W to Kern Co. and adjacent Inyo Co.) and Baja California ***Diplacus fremontii***

**DIPLACUS OVATUS** (A. Gray) Nesom, **comb. et stat. nov.** *Mimulus bigelovii* A. Gray var. *ovatus* A. Gray, Syn. Fl. N. Amer. (ed. 2) 2(1): 445. 1886. *Mimulus ovatus* (A. Gray) N. Holmgren, Intermount. Fl. 4: 362. 1984. **LECTOTYPE** (Grant 1924, p. 282): USA, Nevada. Washoe Co.: Lake Washoe ["Steamboat Springs" on one of the NY sheets], 1865, J. Torrey 372 (GH; isoelectotypes: NY-2 sheets digital images!).

Thompson rejected Grant's lectotype (2005, p. 87; annotations in 1992 on Torrey 372 at GH and NY) "because it is a hybrid between *M. cusickii* and *M. nanus* var. *mephiticus*" and because his choice as a replacement (p. 82) best reflected Gray's original intent, since significant elements of his morphological description came from Oregon specimens: USA. Oregon. Int. of Oregon, mountains, 1875, R.D. Nevius s.n. (GH). On the other hand, Grant's choice does not appear to have been in conflict with the protologue, even though it is clear that the syntypes included heterogeneous elements.

In fact, a resolution of the situation here appears to correspond closely to Recommendation 9A.5 of the ICBN: "When two or more heterogeneous elements were

included in or cited with the original description or diagnosis, the lectotype should be so selected as to preserve current usage. In particular, if another author has already segregated one or more elements as other taxa, one of the remaining elements should be designated as the lectotype provided that this element is not in conflict with the original description or diagnosis." Grant's lectotype preserves current usage of the name *Mimulus ovatus* (and would have done so in 2005) and there is no compelling reason to reject it, especially since plants of the Nevada collection are not regarded as hybrids here or by Nevada biologists.

Thompson (2005) placed *Mimulus bigelovii* var. *ovatus* as a synonym of *M. cusickii* (Greene) Rattan, as did Grant (1924), but it was treated as distinct and raised to specific rank by Holmgren (1984). Holmgren noted the following: "Some collections of *M. ovatus* have been treated as a northern extension of *M. bigelovii* by some and as a southern extension of *M. cusickii* by others. However, the taxon appears to be more closely allied to the *M. mephiticus*-*M. coccineus*-*M. densus* complex." He described the range of *Mimulus ovatus* as southern Washoe, Ormsby [Carson City], and Douglas counties, Nevada, distinct from *M. cusickii*, which he treated as a more widespread and more northern species, not reaching Nevada and not overlapping in distribution with *M. ovatus*.

Thompson mapped essentially the same distribution for *Mimulus cusickii* as Holmgren described, moving the lectotype of var. *ovatus* to a collection from Oregon, rejecting the earlier lectotype designation by Grant (see comments above) and leaving the Nevada plants without a name. He cited a collection of the Nevada plants as intermediate between *M. cusickii* and *M. namus* var. *mephiticus*: Washoe Co.: 2.8 mi E of Hwy 395 along Geiger Grade (Hwy 341), T18N, R20E, S35, Thompson 970 (ID, ORE, OSC, RENO, RSA, UC). Neither Holmgren nor Thompson, however, regarded *M. cusickii* as occurring in the vicinity of southern Washoe, Ormsby, and Douglas cos., Nevada, thus it is unlikely that plants from that area show genetic influence of *M. cusickii*.

In fact, the Nevada plants identified as *Mimulus ovatus* (including Thompson 970, cited above) are tracked by the Nevada Natural Heritage Program and the taxon is on the state's Plant and Animal At-Risk Tracking List of 2010, listed as G1G2Q S1S2 (NNHP 2012). A "Rare Plant Fact Sheet" for *M. ovatus* and a number of excellent photos (James Morefield and Gary Monroe; localities in Washoe Co. – Geiger Grade and the Carson City area – Eagle Valley) of the plants are provided on the same website.

Distinctions between *Diplacus ovatus* and *D. cusickii* are tentatively summarized in the following couplet.

- |   |                                 |
|---|---------------------------------|
| 1. Stems 2–14 cm, usually highly branched, leaf apices acute to obtuse; calyces 7–9(–10) mm; corolla tube-throats (14–)17–21 mm, capsules 6–8 mm, not exceeding the calyx                                   | <b><i>Diplacus ovatus</i></b>   |
| 1. Stems (1–)3–24(–35) cm, usually simple or few-branched, leaf apices sharply acuminate or cuspidate, calyces (9–)10–17 mm, corolla tube-throats (15–)20–28 mm, capsules 10–17 mm, usually exceeding calyx | <b><i>Diplacus cusickii</i></b> |

### Status of *Mimulus spissus*

Thompson treated *Mimulus spissus* as a synonym of *M. bigelovii* var. *cuspidatus*, but Holmgren (1984, p. 361–362) regarded it as a distinct species, comparing it directly to var. *cuspidatus*. "The broadly obovate, cuspidate leaves resemble those of *M. spissus*, but are larger. The main leaves of var. *cuspidatus* are 20–42 mm long and 10–20 mm wide, whereas in *M. spissus* the leaves are 8–18(–22) mm long and 4–10(–14) mm wide. Plants identifiable to var. *cuspidatus* may have arisen more than once through hybridization with *M. spissus* which would account for its sporadic distribution across the geographic contact of *M. bigelovii* and *M. spissus*."

As illustrated and described by Holmgren, and as alluded to by Grant's choice of epithet (Latin, *spissus*, thick, dense, crowded) and her choice of a type specimen, the leaves and flowers of *Mimulus spissus* characteristically are densely crowded. Thompson did not comment directly on Holmgren's view, but he did note that internodes of var. *cuspidatus* are "sometimes more congested near stem tips under conditions of severe drought stress," this condition accompanied by scorched basal leaves. Leaf dimensions given by Thompson for var. *cuspidatus* essentially encompass the total range for var. *cuspidatus* and *M. spissus* given by Holmgren.

*Mimulus spissus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 277. 1924. TYPE: USA. Nevada. [Esmeralda Co.: Silver Peak Mts., 5000 ft., 29 Sep 1915, E.A. Goldman 2548 (holotype: US digital image!, photo MO).

#### **Status of *Mimulus angustifolius*, *Mimulus densus*, and *Mimulus coccineus* var.**

Thompson (2005) treated *Mimulus angustifolius* simply as a synonym of *Mimulus nanus* var. *mephiticus* (Greene) Thompson, but Holmgren (1984) noted that it may be a high elevation ecotype of *M. densus* A.L. Grant. *Mimulus angustifolius* is listed on Nevada's Plant and Animal Watch List of 2010 (NNHP 2012) and is said to be known only from the vicinity of Mt. Rose in the Carson Range of Washoe County.

Holmgren treated *Mimulus coccineus* Congdon and *Mimulus densus* A.L. Grant as distinct species but Thompson considered both (along with *M. angustifolius*) as synonyms of *M. nanus* var. *mephiticus*. Holmgren noted that "so close are the members of this complex [*M. coccineus*, *M. densus*, and *M. mephiticus*] that they are probably best treated as varieties under the oldest name *M. mephiticus*." This whole group of plants need further study.

*Mimulus coccineus* Congdon, Erythra 7: 187. 1900. TYPE: USA. California. [Madera Co.: mountain side east of Minarets, in volcanic land, 19 Aug 1899, J.W. Congdon s.n. (holotype: UC digital image!; isotypes: DS digital image!, MIN).

*Mimulus densus* A.L. Grant, Ann. Missouri Bot. Gard. 11: 298. 1924. TYPE: USA. Nevada. Lander Co.: Toiyabe Range, hills around Austin, 6400 ft, 21-24 Jul 1913, P.B. Kennedy 4401 (holotype: MO digital image!; isotypes: DS digital image!, PH).

*Mimulus angustifolius* (Greene) A.L. Grant, Ann. Missouri Bot. Gard. 11: 298. 1924. *Eunamus angustifolius* Greene, Pittonia 2: 23. 1889. TYPE: USA. Nevada. [Washoe Co.:] on trail from Bronco to Mt. Rose, western slope of Washoe Mts., Jul 1889, C.F. Sonne 14 (holotype: ND-Greene; isotypes: PH, UC); not *Mimulus angustifolius* Hochst. ex A. Rich., Tent. Fl. Abyss. 2: 119. 1850 (= *Mimulus gracilis* R. Br.).

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## TAXONOMIC REVISION OF *DRESSLERIA* (ORCHIDACEAE, CATASETINAE)

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### ABSTRACT

A taxonomic revision of the neotropical orchid genus *Dressleria* Dodson is presented. A total of 12 species are included, a key to identification is given, and all species are illustrated with photographs or line drawings. *Dressleria williamsiana* H.G. Hills, sp. nov., is described.

**KEY WORDS:** *Dressleria allentii*, *Dressleria aurorae*, *Dressleria bennettii*, *Dressleria dilecta*, *Dressleria dodsoniana*, *Dressleria eburnea*, *Dressleria fragrans*, *Dressleria helleri*, *Dressleria kalbryeri*, *Dressleria kerryae*, *Dressleria severiniana*, *Dressleria williamsiana*, Orchidaceae, Catasetinae

The genus *Dressleria* was established by Dodson (1975) for a group of species previously included in a broadly defined *Catasetum* L.C. Rich. *Dressleria* is distinguished from *Catasetum* by having consistently bisexual flowers, persistent leaves, and large inflorescence bracts (Fig. 1). *Dressleria* differs from a second segregate from *Catasetum* with bisexual flowers, *Clowesia* Lindl. by having the lip adnate to the column, fleshy flowers, and pollinia under pressure but lacking a trigger. *Dressleria* plants are characteristically pale green and bear white to greenish or yellowish flowers noted for their strong fragrances. Unlike *Catasetum* and *Clowesia*, pollinia of *Dressleria* become attached to the underside of the pollinator rather than onto the back of the pollinator.

Subtribe *Catasetinae* Schlechter comprises five genera: *Catasetum*, *Clowesia*, *Cynoches*, *Dressleria*, and *Mormodes*. Phylogenetic analysis by Pridgeon and Chase (1998) demonstrated that all five genera of *Catasetinae* are monophyletic and fall into two clades. In one clade *Clowesia* is sister to *Catasetum*. In the second clade *Cynoches* is sister to *Mormodes* and *Dressleria* sister to them both. These results as well as those from chloroplast DNA studies by Chase and Hills (1992) suggest that bisexuality with protandry has arisen twice in the evolution of the subtribe. This was first proposed by Chase and Pippen (1990) in a study of seed coat morphology.

Several problems are apparent in previous studies of *Dressleria*. First, as is true of many other groups of fleshy flowered orchids, it is helpful to work from fresh or liquid preserved material. Second, there are few preserved specimens. This is probably partially due to the difficulty of maintaining plants in greenhouse culture where they are often treated as being like the ecologically very different catasetums. The flowers last only 5-7 days; therefore field collections of pressed flowers are rare. Finally many of the published illustrations do not show the size and shape of the opening to the sac of the lip that is one of the more diagnostic characters in separating species. Some published illustrations have been made from previously dried and inadequately hydrated flowers and lack critical details.

When studying the fragrances of *Dressleria* flowers (Hills unpublished), some undescribed entities were noted. When Dodson (1975) proposed *Dressleria*, he suggested that the plants from western Ecuador might well be a distinct but similar species to what he then referred to as *D. eburnea* from eastern Ecuador. Examination of the type specimens of *Catasetum eburneum*, *C. suave*, *Dressleria helleri*, and drawings and photographs of the type of *Catasetum dilectum* has led to the

reduction of *D. suave* as a valid species to a synonym of *D. eburnea* and publication of nine additional species (Hills 1993, 2000, 2005; Bennett & Christenson 1995; Dodson 1998).

*Dressleria* species are most easily identified from flowers that have been allowed to mature before being photographed, drawn or preserved because the position of sepals and petals is useful in distinguishing species. The final position of the segments is not fixed until 2-3 days after the flowers open, at which time floral fragrance is evident. Fragrance too is a useful character but unfortunately it is available only on fresh flowers. It is essential to view the opening to the saccate portion of the lip to distinguish species.

Much of the material cited here has been prepared from cultivation. In some instances multiple specimens have been prepared from the same cultivated plant. When known, the source of living material is listed first, followed by a listing of all specimens that have been made from that living clone. These are indicated as "ex hort." and include living collection accession number, date, and the name and number of the person who prepared the specimen. Accession numbers for living material are assigned by the following institutions: CA, K, MO, SEL (MSBG), and UF.

**DRESSLERIA** Dodson, Selbyana 1: 131. 1975. **TYPE:** *Catasetum dilectum* Rehb. f. = *Dressleria dilecta* (Rehb. f.) Dodson.

**Plants** epiphytic with basal vermiform roots. **Pseudobulbs** fusiform-cylindrical, approximate, fleshy, fibrous, concealed by persistent leaf bases with new growth arising near base of pseudobulb. **Leaves** oblong-lanceolate, apically acute, membranaceous, persistent, alternate, distichous; leaf-blade prominently veined abaxially. **Inflorescences** basal, suberect, subcapitate or few-flowered racemes, with prominent, inflated bracts (Fig. 1). **Flowers** nonresupinate, white, greenish white, or pale yellow, fleshy, strongly fragrant when fresh. **Sepals and petals** subsimilar, linear-lanceolate to elliptic, often reflexed and recurved or spreading. **Lip** unlobed, saccate, basally adnate to column, often with a callus ridge surrounding the opening. **Column** short, stout, fleshy. **Pollinia** 2, borne on a common stipe with a viscidium. **Capsule** elliptic.



Figure 1. *Dressleria* plant showing large bracts on the developing inflorescence, a distinguishing characteristic for the genus

### Key to the species of *Dressleria*

1. Lip adnate to column more than half its height.
  2. Inflorescence loosely flowered raceme.
    3. Opening of sac nearly square-shaped, 4.5 mm high, 4.5 mm wide; central-western Panama ..... *Dressleria severiniana*
    3. Opening of sac rectangular, 2-3.5 mm high, 1.5-2 mm wide at base of column; eastern Panama and northwestern Colombia ..... *Dressleria kerryae*
  2. Inflorescence subcapitate.
    4. Opening of sac heart-shaped, wider (4.5 mm) distally away from column; Costa Rica and Nicaragua ..... *Dressleria helleri*
    4. Opening of sac more or less rectangular, wider (6.5 mm) proximally near column; Costa Rica ..... *Dressleria dilecta*
1. Lip adnate to column less than half its height.
  5. Petals strongly reflexed, appressed to ovary; callus prominent distally of "M-shaped" opening of sac; Costa Rica and Nicaragua. .... *Dressleria eburnea*
  5. Petals not reflexed, or if reflexed then not tightly appressed to ovary; Panama, Columbia, Ecuador, Venezuela, or Peru.
  6. Lip less than 1.5 cm long.
    7. Sepals 5.5 mm wide, narrower than petals; northeastern Columbia and Andean Venezuela ..... *Dressleria kalbreyeri*
    7. Sepals 9 mm wide, nearly as wide as petals; Panama or Peru.
      8. Lateral sepals reflexed nearly to ovary; lip rounded apically with a well-defined callus surrounding a cordate opening of sac; Panama ..... *Dressleria allenii*
      8. Lateral sepals spreading; lip acute apically without a callus surrounding a throat like rectangular opening of sac; Peru. .... *Dressleria aurorae*
  6. Lip more than 1.5 cm long.
    9. Lip with prominent callus;
      10. Callus triangular, prominent partially obscuring the opening of sac; south eastern Peru. .... *Dressleria bennettii*
      10. Callus tongue-like, extending from the tooth in opening of sac to tip of lip; northwestern Ecuador and southwestern Colombia. .... *Dressleria williamsiana*
    9. Lip callus not prominent;
      11. Opening of sac rectangular; western Ecuador ..... *Dressleria fragrans*
      11. Opening of sac "X-shaped"; Amazonian Ecuador and Peru ..... *Dressleria dodsoniana*

1. **DRESSLERIA ALLENII** H.G. Hills, *Lindleyana* 15: 171. 2000. TYPE: PANAMA, without locality, 1976, N.H. Williams, ex hort MSBG 1976-5619, 18 Sep 1978, *J.D. Ackerman 1336* (holotype SEL). Figs 2 & 3

**Pseudobulbs** fusiform, to 10 cm tall, 2–3 cm wide. **Leaves** to 35 cm long, to 5 cm wide. **Inflorescence** basal, loosely flowered raceme to 25 cm. **Pedicels** to 3 cm long. **Flowers** white, nonresupinate, saccate. **Sepals** 17–18 mm long, 8–9 mm wide, reflexed along the ovary. **Petals** 14–15 mm long, 11–12 mm wide, spreading. **Lip** nearly round, apex not beaked, 16–17 mm long, 13–14 mm wide. Opening to the sac cordate 5.0–6.5 mm wide x 4.0–4.5 mm high, callus thin not prominent. **Column** 6–7 mm long, 6–7 mm wide at base. **Fruit** not seen



Figure 2. *Dressleria allenii* H.G. Hills. Photo of clonotype MSBG 1976-5619 by Mark W. Chase. The plant is still growing at MSBG.

*Dressleria allenii* is similar to *D. eburnea*. Allen (1949) correctly noted that the flowers agreed in nearly every detail with the description of *Catasetum eburneum* except that the flowers were smaller. Figure 3 drawn to scale, shows the difference in size between the two species. A good field character is that the sepals and petals of *D. eburnea* reflex fully along the ovary while only the sepals of *D. allenii* reflex while the petals are in the same plane as the lip.

**Distribution:** Panama

Additional specimens examined. PANAMA: Prov. Cocle, Cerro Campana, *P.H. Allen 4559* (AMES spirit #P2722, photo SEL). All of the following specimens are collected from the same cultivated plant as the holotype. Panama without locality, 1976, N.H. Williams, ex hort MSBG 1976-5619, *without collector s.n.* (SEL), Aug 1985, *E.A. Christenson s.n.* (SEL), 13 Aug 1987, *H.G.*

*Hills 87183* (AMES spirit); 15 Aug 1989, *H.G Hills 89031* (SEL spirit); 30 Aug 1990, *H.G Hills 90024* (NCU, K spirit); 14 Sep 91, *H.G Hills 91023* (NCU, AMES spirit); 30 Jul 1991, *S.W. Ingram 1082* (SEL, NCU, AMES spirit); 19 Aug 1994, *W.M. Whitten 94068* (FLAS).

**Etymology:** Named in honor of the late Paul Hamilton Allen (1911-1963), coauthor of the *Orchidaceae* for the *Flora of Panama*, who had a long-time interest in the *Catasetinae*.

**Fragrance:** Methyl benzoate, methyl salicylate and eugenol.

**Illustration:** Allen (1949) as *Catasetum eburneum*. The Allen illustration was apparently done on an immature flower and does not show the reflexed sepals.

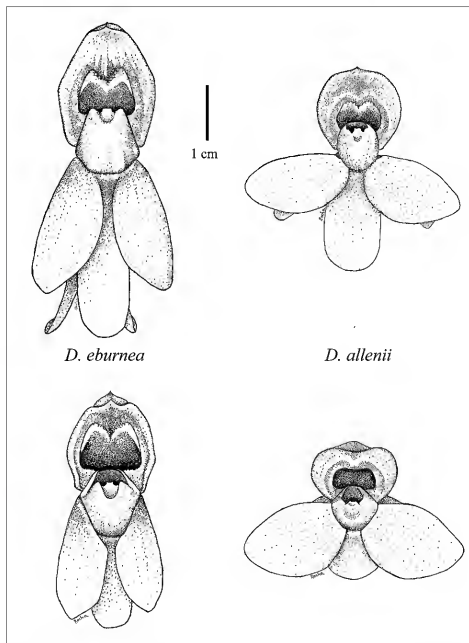


Figure 3. Size comparison of *Dressleria eburnea* (Rolfe) Dodson (*M.W. Whitten 1022*) with *D. allenii* H.G Hills (*H.G Hills 89031*). Each species produces a unique fragrance. Drawing by Omar E. Rocha G

2. **DRESSLERIA AURORAE** H.G. Hills & D.E. Benn., *Brittonia* 47: 184. 1995. **TYPE** **PERU** Depto. de Huanuco, Tinga Maria, without exact locality, E. Jara, ex hort, 15 Jul 1989, *H.G. Hills 89030* (holotype: AMES [not yet sent], isotype: SEL spirit) Figs. 4 & 5.

**Pseudobulbs** fusiform, to 10 cm tall, 2–3 cm wide. **Leaves** to 35 cm x 6 cm wide. **Inflorescence** basal, arching, loosely flowered raceme, to 35 cm long. **Pedicels** to 3.0 cm long. **Flowers** pale white tinted with green, nonresupinate, saccate. **Sepals** dorsal sepal linear, acute apically, 16–18 mm long, 6.5–7 mm wide, reflexed along the ovary, lateral sepals linear acute apically, strongly divergent, 16–18 mm long, 6.5–7 mm wide. **Petals** ovate, acute apically, 15–16 mm long, 8–10 mm wide. **Lip** elliptic-ovate, acute apically, adnate to basal third of column, 14–15 mm long, 12–14 mm wide, sac transverse, obscurely 2-lobed with a throat like entrance to the rectangular opening. **Column** 5.5–6 mm long, 5.5–6 mm wide at base. **Fruit** not seen.

*Dressleria aurorae* with very small flowers is similar to *D. dodsoniana* but has been confused with *D. eburnea*. *Dressleria aurorae* differs from *D. eburnea* by lacking reflexed sepals and petals, lacking a callus around the opening to the sac, and by possessing a different array of floral fragrances. *Dressleria aurorae* differs from *D. bennettii* because of its smaller flowers with relatively wider sepals and lack of prominent callus. The opening to the sac is at the base of the throat-like lip lacking prominent lateral projections found in *D. dodsoniana*.

The description and illustration given in the original description (Christenson and Bennett 1995) refers to a specimen of *Dressleria dodsoniana* and not to *D. aurorae*.



Figure 4. *Dressleria aurorae* H.G. Hills & D.E. Benn. Photo of holotype *H.G. Hills 89030* by Bart Schutzman

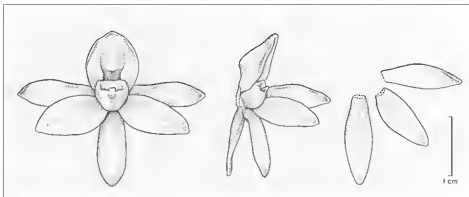


Figure 5. *Dressleria aurorae* H. G. Hills & D.E. Benn. Drawing of holotype *H.G. Hills 89030* by Bobbi Angell.

**Distribution:** Peru.

Additional specimens examined **PERU** Depto de Huanuco, Leonio Prado, Caserio Clorinda Matos, 780 m 15 Dec 1995, *E. Jara P. ex Bennett 7424* (MOL).

**Etymology:** Named in honor of Aurora Pastorelli de Bennett (1925-), wife of David E. Bennett, Jr.

**Frangrance:** methyl salicylate with trace of methyl benzoate

**Illustrations:** The illustration of Bennett and Christenson (1995) and used again in (1998) is not drawn from the holotype and is in fact an illustration of *Dressleria dodsoniana*. The leaf with a midvein is in error and does not represent *Dressleria* leaves.

**3. DRESSLERIA BENNETTII** H.G. Hills & Christenson, Brittonia 47: 186. 1995. **TYPE:** **PERU** Depto De Junin, Chanchamayo, Ubiriki Valley, north side of Rio Perene, Oliveras, 6 June 1991, ex hort 23 June 1991, *D.E. Bennett Jr. 5064-2* (holotype NCU, isotypes NY, K spirit) Fig. 6

**Pseudobulbs** fusiform to 12 cm tall, 2–4 cm wide. **Leaves** to 40 cm long, 6 cm wide. **Inflorescence** basal, arching, loosely flowered raceme, to 30 cm. **Pedicels** to 3 cm long. **Flowers** yellow to orange, nonresupinate, saccate. **Sepals:** dorsal sepal linear reflexed along the ovary 25–30 mm long, 7–8 mm wide, lateral sepals spreading, 23–25 long, 7–8 mm wide. **Petals** ovate 20–23 mm long, 11–14 mm wide. **Lip** ovate 22–23 mm long 17 mm wide with pronounced triangular callus to each side of the opening. Opening of the sac 4–5 mm wide at base of column, 4 mm high with a prominent tooth. **Column** 7–8 mm long, 10–11 mm wide at base. **Fruit** not seen.

**Distribution:** Peru

Additional specimens examined **PERU** Depto De Junin, Chanchamayo Ubiriki Valley, north side of Rio Perene, Oliveras 06 June 1991, D.E. Bennett 5064-2 ex hort same plant as the holotype, 09 Jul 1992, *H.G. Hills 92009* (AMES, SEL), Chanchamayo, Ubiriki Valley, north side of Rio Perene, Oliveras 06 June 1991, D.E. Bennett 5064-1 ex hort same field collection as the holotype, 03 Jul 1992, *H.G. Hills 92008* (NCU, SEL spirit)

**Etymology:** Named in honor of David E. Bennett, Jr (1923-2009), major contributor to our knowledge of Peruvian orchids

**Fragrance:** methyl salicylate with trace of methyl benzoate

**Illustrations:** A color photograph of the type plant of *Dressleria bennettii* was published by Christenson (1994). Bennett and Christenson (1995 & 1998) used the same illustration drawn from the holotype plant.



Figure 6. *Dressleria bennettii* H.G. Hills & Christenson. Holotype (D.E. Bennett Jr. 5064-2). Photo by Benjamin Collantes

4. **DRESSLERIA DILECTA** (Rehb. f.) Dodson, Selbyana 1: 132. 1975. *Catasepium dilectum* Rehb. f., Beitr. Orchid.-K. C. Amer.: 73. 1866. **TYPE:** COSTA RICA. Prov. Heredia, Cartablanca, 10 May 1857, *Wendland* 833 (holotype: W; photos of holotype: AMES, SEL). Figs. 7 & 11.

**Pseudobulbs** fusiform to 10 cm tall, 2–3 cm wide. **Leaves** to 45 cm, to 6 cm wide. **Inflorescence** basal, erect, densely flowered, subcapitate to 20 cm. **Pedicels** to 3 cm long. **Flowers** white, nonresupinate appearing nearly round. **Sepals** 17–19 mm long, 6.5–7 mm wide strongly reflexed against the ovary. **Petals** 14–15 mm long, 10–11 mm wide strongly reflexed to the ovary. **Lip** 15–16 mm long, 12–13 mm wide. Apical half of the lip flat or slightly reflexed. Callus of the lip elevated 2–3 mm to make the lip entirely adnate to the column. Margin of opening erose distally, opening rhombic, 5.5–6 mm at the widest point, 2.5–3 mm high. **Column** 7–8 mm long, 8–9 mm wide at the base. **Fruit** not seen.





Figure 7. *Dressleria dioeca* (Rchb. f.) Dodson. Photo by Calaway H. Dodson.

*Dressleria dilecta* is similar to and has been confused with the sometimes sympatric *D. helleri* with which it shares a subcapitate inflorescence. The inflorescences of *D. dilecta* are usually more densely flowered than those of *D. helleri*. The opening to the sac of *D. dilecta* is rhombic whereas that of *D. helleri* is cordate. The two species differ by their floral fragrances. There is gradation in floral form between *D. dilecta* and *D. helleri* and it is conceivable that the species hybridize in nature despite the fragrance differences. In addition, the flowers of both *D. dilecta* and *D. helleri* in the Cariblanco area of Costa Rica show some variation where the two species are sympatric with *D. eburnea*.

The *Lanckester 1181* specimen of *Dressleria dilecta* is enclosed in the folder with the isotype specimen of *D. suave* and has probably added to the confusion when samples were sent to AMES for identification. There is also a spirit specimen of *Lanckester 1181* at AMES.

**Distribution:** Costa Rica

**Additional specimens.** COSTA RICA: Prov. of Alejuela, Virgen, 1984, *M.W. Chase 84205A* (K). Many plants were collected in Prov. of Heredia, Rt 9 at km 47, Sarapiquí River Valley, Mar 1986, Hills, Whitten & Ballestar ex hort. F1085, 11 Jun 1986, *H.G. Hills 1019* (FLAS, SEL spirit); 26 Jun 1989, *W.M. Whitten 1021* (FLAS); 24 Jun 1991, *S.W. Ingram 971* (SEL); ex hort. F1048, 21 May 1987, *H.G. Hills 87179* (SEL spirit); ex hort. F1050, 11 Nov 1987, *H.G. Hills 87144* (FLAS, SEL spirit); 03 Jun 1991, *S.W. Ingram & Ugucioni s.n.* (SEL); ex hort. F1086, 22 May 1987, *H.G. Hills 87182* (SEL spirit); [unstudied University of Florida accession], 21 Jun 1989, *W.M. Whitten 1019* (FLAS); ex hort. F1084, 29 Jun 1989, *W.M. Whitten 1020* (FLAS); near San Carlos, Laguna de Maria Alguilar, 800 m, March 1986, C. Horich, ex hort. 1987, *R. Jenny s.n.* (AMES spirit); Cariblanco, A. Delgado, ex hort. 7 Jun 1957, *C. Lanckester 1695* (SEL); Prov. of Limón, lower Rio Reventazón near Pascuas, 350 m, C. Horich, ex hort. MO 60-7-53, without collector (MO, SEL spirit #4182); without location, ex hort., Apr 1955, *C. Lanckester s.n.* (SEL); without location, ex hort. *H. Teuscher s.n.* (SEL spirit #4186); without location, Carrillo, ex hort. May 1928, *C. Lanckester 1181* (AMES).

**Etymology:** From Latin *dilectus*, beloved.

**Fragrance:** alpha pinene, beta ocimene, 1,8 cineole and p-dimethoxybenzene. The 1,8-cineole should be easily detected early morning.

**Illustrations:** Teuscher (1972) as *Catasetum dilectum*; Bechtel and Cribb (1980) as *Dressleria dilecta*; Jenny (1981) as *Dressleria dilecta*; Batchelor (1983) as *Catasetum eburneum*; Rodrigues C. et al. (1986) as *Dressleria dilecta*; Dressler (1993) as *D. dilecta*.

**Pollination:** Lanckester (1960) observed pollination by *Euglossa species*. Dodson (1975) reported pollination by *Euglossa hansoni* at San Vito de Java, Costa Rica.

**5. DRESSLERIA DODSONIANA** H.G. Hills, Orquideologia 24: 133. 2005 (published 2006). **TYPE:** ECUADOR. Amazonia without location, *D. Delasandro*. ex hort. 23 Sep 2003, *H.G. Hills 20030919* (holotype: FLAS; isotypes: AMES spirit, SEL spirit). Fig. 8.

**Pseudobulbs** fusiform to 12 cm tall, 2–4 cm wide. **Leaves** to 35 cm long, to 6 cm wide. **Inflorescence** basal, arching, loosely flowered raceme, to 35 cm. **Pedicels** to 4 cm long. **Flowers** whitish green, nonresupinate, saccate. **Sepal:** dorsal sepal linear, 24–26 mm long, 6–6.5 mm wide, reflexed along the ovary; lateral sepals linear-oblong, obtuse apically, strongly divergent, 23–25 mm long, 6–6.5 mm wide. **Petals** obliquely ovate, obtuse apically, 21–23 mm long, 10–12 mm wide. **Lip** elliptic-ovate, acute apically, adnate to basal third of column, 20–22 mm long, 12–14 mm wide; sac

transverse, obscurely 2-lobed with an "X-shaped" opening wider distally than at base of column  
**Column** 5.5–6 mm long, 7.5–8 mm wide at base **Fruit** not seen



Figure 8. *Dressleria dodsoniana* H.G. Hills. Holotype (H.G. Hills 20030919).

*Dressleria dodsoniana* is allied to *D. fragrans* but differs by having a narrower opening to the sac with prominent lateral projections creating an X-like opening unlike the rectangular opening of *D. fragrans*. The floral fragrance of *D. dodsoniana* is primarily methyl salicylate with a minor component of methyl benzoate while the floral fragrance of *D. fragrans* is wholly eugenol.

Dodson once considered everything in South America to be *Dressleria eburnea* even though he himself mentioned that the material from eastern Ecuador was probably a different species from the western Ecuador material.

**Distribution:** Amazonian Ecuador, and northern Peru.

Additional specimens examined. ECUADOR: Prov. Napo-Pastaza, Mera, 16 Feb 1956, *Asplund 19404* (AMES, K, NY); without location, 8 Mar 1940, *Lugo 34* (Herb. Garay); Hacienda San Antonio Baron von Humboldt, 2.5 km north of Mera on road from Baños to Puyo, 14 Mar 1985, *C.H. Dodson & L.M. Bermeo 15679* (MO); Motolo, 11 Mar 1969, *Lugo 694* (GB); without location, 20 Jul 1972, *Lugo 1933* (GB); Lumbaquí, road from Baeza to Lago Agrio 9 Feb 1986, *A. Hirtz et al. 2713* (MO); Prov. of Tungurahua, San Francisco on road from Baños to Puyo, 12 Mar 1963, *C.H. Dodson & L. Thien 2366* (SEL); Prov. of Morona-Santiago, Río Upano near Macas, 29 Aug 1987, de K. G. Lacerda et al. ex hort. F87031, 27 Dec 1987, *H.G. Hills 87143* (FLAS); *W.M. Whitten s.n.* (FLAS). Amazonian Ecuador without exact location, ex hort. 13 Dec 2002, *H.G. Hills 20021201* (SEL spirit). PERU: Depto. San Martin, Tarapoto, at km 30 on road from Tarapoto to Yurimaguas, 650 m, 10 April 1965, *D.E. Bennett & A. Bennett 1699* (MOL, illustration only).

**Etymology:** The species name honors Calaway H. Dodson (1928- ), whose lifetime contributions to orchid biology and taxonomy are both legendary and too numerous to list.

**Fragrance:** methyl salicylate with a trace of methyl benzoate.

**Illustration:** L.C. Vieira (1990), as *Dressleria eburnea*.

**Pollination:** *Eufriestia concave* observed by Dodson 1996 (pers. comm.). This observation was of a plant collected in eastern Ecuador being grown on the Pacific side. It is not known if the same species of bee pollinates *Dressleria dodsoniana* in its native habitat.

6. **DRESSLERIA EBURNEA** (Rolf) Dodson, Selbyana 1: 132. 1975. *Catasetum eburneum* Rolf, Kew Bull. 1906: 86. 1906. LECTOYPE (designated here): COLOMBIA. near Pamplona, ex hort. 19 Sep 1901, *Charlesworth & Co. s.n.* (K); two other collections on the same sheet are dated Sep 1900 and Aug 1903 respectively. Figs. 3 & 9.
- Dressleria suavis* (Ames & C. Schweinf.) Dodson, Selbyana 1: 132. 1975. *Catasetum suavis*. Ames & C. Schweinf., Sched. Orchid. 10: 81. 1930. TYPE: COSTA RICA. Prov. of Heredia, La Fuente, 1200 m, 16 Aug 1925, *A. Alfaro 162*. (holotype: US; isotype: AMES).

**Pseudobulbs** fusiform to 12 cm, 2–3 cm wide. **Leaves** to 40 cm, to 7 cm wide. **Inflorescence** basal, loosely flowered raceme, to 35 cm. **Pedicels** to 4 cm long. **Flowers** ivory white, nonresupinate, saccate. **Sepals** 22–30 mm long, 11–12 mm wide strongly reflex along the ovary. **Petals** 22–24 mm long, 14–16 mm wide strongly reflex along the ovary. **Lip** longer than broad, 20–22 mm x 12–16 mm. Top half of the lip beaked. **Callus** very prominent on sides and top of opening elevated 2 mm. Opening to the sac large nearly 8–9 mm wide at the base of the column, 5–6 mm high. **Lip** adnate to the bottom half of the column. **Column** 9–10 mm long, 8–9 mm wide at the base. **Fruit** not seen.

The type sheet of *Catasetum eburnea* at K includes three collections of the species. One of these, dated 1901, was transmitted by the firm of Charlesworth & Co. and is here designated as the lectotype. The collection reportedly came from the Pamplona District of Colombia. No subsequent specimens of *D. eburnea* are known from South America and the type locality almost certainly is erroneous.

*Dressleria* collections from east of Pamplona have been identified as *D. kalbreyeri*. A source of confusion regarding application of *C. sauve* initially was caused because of an unpublished illustration associated with the protologue. The drawing, attached to a specimen of *D. dilecta* *Lankester 1181*, (AMES), is that of *D. eburnea*. Ames and C. Schweinfurth stated specifically that “the description was drawn from dried specimens supplemented by flowers preserved in formalin”.

The flowers preserved in formalin are those of *D. dilecta* obtained by Lankester when he prepared his dried specimen 1181. This combining of material from two different species likely hindered the recognition of additional species when additional material was sent to AMES for identification.

Dodson annotated the type specimen of *Catasetum suave* as *Catasetum eburneum* but chose to maintain *C. suave* when he proposed the genus *Dressleria*. Mansfeld (1932) noted that he did not see the material at AMES when he reduced all the material to *Catasetum dilectum*. Mansfeld did annotate the specimen at Kew. The description of both *Catasetum eburneum* and *C. suave* state that the sepals and petals are reflexed unlike the spreading segments of most of the South American species that have been called *D. eburnea*.



Figure 9. *Dressleria eburnea*. (Rolfe) Dodson. Photos by Calaway H. Dodson.

**Distribution:** Costa Rica and Nicaragua.

Additional specimens examined **COSTA RICA**: Prov. of Alejuela, Fortuna-Palma Road, North Slope Volcan Arenal, Luther, Skotat & Bak 25 Jun 1990 ex hort MSBG 1990-0738, 16 Jun 1997, *H.E. Luther s.n.* (SEL), Prov. of Heredia, La Fuente, 1100m, 7 Sep 1924, *A. Alfaro s.n.* (US), Rt 9 at km 47, Sarapiquí River Valley, Mar 1986, Hills, Whitten & Ballestar, ex hort F1045, 26 June 1989, *W.M. Whitten 1022* (FLAS.), without location, ex hort MO 64-98-3 (SEL spirit # 4532), without location, ex hort MSBG 1991-0327, 8 Jun 1992, *S.W. Ingram 1040* (SEL, AMES spirit, K spirit) **NICARAGUA**: Prov. of Zelaya: Cerro Musún, 915 m, *A. H. Heller 5081* (SEL, drawing only); without location, ex hort Montreal 2175-16, *H. Teuscher s.n.* (AMES spirit P3258).

**Etymology:** From Latin *eburneus*, ivory white.

**Franchise:** 1,8-cineole, methyl benzoate and methyl salicylate.

**Illustrations:** Hamer (1982c) as *Dressleria suavis*, redrawn from Heller's illustration of *Heller 5081*, *Dressleria suavis* (Ames & C. Schweinf.) Dodson, Selbyana 1: 132. 1975, figure 1c, Herrera, C & N Zamora (2003) as *Dressleria dilecta*.

7. **DRESSLERIA FRAGRANS** Dodson, *Orquideologia* 21: 3. 1998. TYPE: ECUADOR. Prov. of Bolívar, 7 km east of Balzapamba on road to San José de Chumbo, region of El Tornado, 1400 m, 16 Jun 1960, C. H. Dodson 100 (holotype SEL, isotype AMES spirit) Fig. 10

**Pseudobulbs** fusiform to 15 cm tall, 2–3 cm wide. **Leaves** to 45 cm, to 7 cm wide. **Inflorescence** basal, arching, raceme, to 25–35 cm. **Pedicels** to 4 cm. **Flowers** greenish yellow, nonresupinate, saccate. **Sepals** dorsal sepal oblong-lanceolate, acuminate to 23 mm long, 9 mm wide, the lateral sepals subsimilar and subequal to the dorsal sepal. **Petals** elliptic, acute, to 20 mm long, 13 mm wide. **Lip** broadly ovate-suborbicular, acute, globose-saccate, fused to the basal third of the column, to 22 mm long, to 15 mm wide, the opening to the sac transversely rectangular, 8 mm wide, 4 mm high, the front edge with a small central tooth, without well-defined lateral callus. **Column** 7–8 mm long, 10–11 mm wide at base. **Capsule** elliptical



Figure 10. *Dressleria fragrans* Dodson. Dodson 8555 (MSBG 1979-1310). Photo by William C. Whitehill. The illustration for the description of *D. fragrans* was drawn from this plant.

*Dressleria fragrans* is similar to *D. dodsoniana*, although authors erroneously have considered this species to be *D. eburnea*. In addition to sharp differences in floral fragrances, *D. fragrans* differs from *D. eburnea* by having non-reflexed lateral sepals and petals and virtually no callus associated with the opening to the sac. The photographs in the envelope attached to the type specimen of *D. fragrans* are those of *D. dodsoniana* a species that occurs in eastern Ecuador. Dodson (pers. comm.) said the photos were attached when he considered everything in South America to be *D. eburnea*.

**Distribution:** Pacific slope Ecuador

Additional specimens examined ECUADOR: Prov. of Cañar, region Cochencya, km 85, Guayaquil-Tambo, alt 400 m, C. Horich, ex hort., Univ. California Botanical Garden, Berkeley

Accession No. 60.1152-1, 60.1152-2 & 60.1152-3, 01 Jan 1961, *C.H. Dodson* 357 (SEL); 7 Nov 1960, *P.C. Hutchison* s.n. (AMES); 15 May 1963, *P.C. Hutchison* s.n. (NY); 28 Oct 1962, *P.C. Hutchison* s.n. (MO); 21 Sep 1963, *P.C. Hutchison* s.n. (US); 29 Sep 1962, *P.C. Hutchison* s.n. (AMES); 7 Dec 1961, *M. Kimnach* s.n. (MO, UC); Ecuador without location, ex hort., 19 Oct 1978, *M. Powers* s.n. (SEL); Prov. of Pichincha, forest of the Cooperative Sta. Marta # 2 at km 3 west of bypass around Santo Domingo, 530 m, 22 Jul 79, *C.H. Dodson, Morgan & T. Dodson* 8555 (MO, SEL; both sterile); forest of the Cooperative Sta. Marta # 2 at km 3 west of bypass around Santo Domingo, 530 m, 22 Jul 79, Dodson, Morgan & T. Dodson 8555 ex hort. MSBG 1979-1310, 7 Sep 1986, *H.G. Hills* 86204 (AMES, FLAS, K spirit, MO, SEL.); 29 Nov 1987, *H.G. Hills* 87141 (FLAS); 6 Sep 1991, *S.W. Ingram* 1112 (NCU); Centinella, ex hort. *Perry* 304 (SEL spirit #5920); Centinella, 12 km east of Patricia Pilar, 700 m, 2 Feb 1987, *C.H. Dodson* 17103 (MO).

**Etymology:** From Latin *fragens*, smelling agreeably.

**Franchise:** 100% eugenol (oil of cloves).

**Illustrations:** Dodson & Dodson (1980) as *Dressleria eburnea*; Arosemena G. et al. (1988) as *D. eburnea*.

**Pollination:** Dodson (1962) observed pollination by *Eulaema cingulata* and described the mechanism. He made a second observation of pollination by *Eulaema cingulata* in 1996 (per. comm.) where he describes *D. dodsoniana* blooming at the same time being pollinated by *Eufriestia concave*. The bees never made a mistake of visiting the other species.

**8. DRESSLERIA HELLERI** Dodson, Selbyana 1:132. 1975. TYPE: NICARAGUA. Dept. Jinotega: coffee plantation at the base of Peñas Blancas, 915 m, 1 Jun 1965, *A.H. Heller* 8422 (holotype: SEL). Fig. 11

**Pseudobulbs** fusiform to 10 cm tall, 2–3 cm wide. **Leaves** to 45 cm, to 6 cm wide. **Inflorescence** basal, erect, subcapitate or somewhat racemose to 20 cm. **Pedicels** to 3 cm. **Flowers** ivory white, nonresupinate, appearing nearly round. **Sepals** 17–19 mm long, 6.5–7 mm wide strongly reflexed along the ovary. **Petals** 14–15 mm long, 10–11 mm wide, strongly appressed to the ovary. **Lip** 15–16 mm long, 12–13 mm wide. Apical half of the lip flat or slightly cupped. **Callus** of the lip elevated 2–3 mm to make the lip entirely adnate to the column. **Margin** of opening erose distally, opening cordate, 4–4.5 mm at the widest point, 4–4.5 mm high. **Column** 7–8 mm long, 8–9 mm wide at the base. **Fruit** not seen.

*Dressleria helleri* is most similar to *D. dilecta* and primarily differs by its shape of the opening to the sac that is cordate and a floral fragrance dominated by beta ocimene and p-dimethoxybenzene. *Dressleria dilecta* has a floral fragrance with alpha pinene, 1,8 cineole and lesser amounts of p-dimethoxybenzene and a more rectangular opening to the sac.

Interpretation of this species has been problematic because the illustration used by Dodson (1975) as well as one of the paratypes cited actually represents *Dressleria kerryae* and not *D. helleri*. By the Rules of Botanical Nomenclature the type material, *Heller* 8422 represents the species and is so interpreted here. Figure 11 illustrates the differences between *D. dilecta* and *D. helleri* and compares their size to *D. eburnea*. Hamer's (1982a) illustration of *D. helleri* is a redrawing of Heller's unpublished illustration based on *Heller* 7094; this is the true *D. helleri*. Hamer's (1982b) illustration of *D. dilecta* is based on *Heller* 8422, the holotype of *D. helleri*.

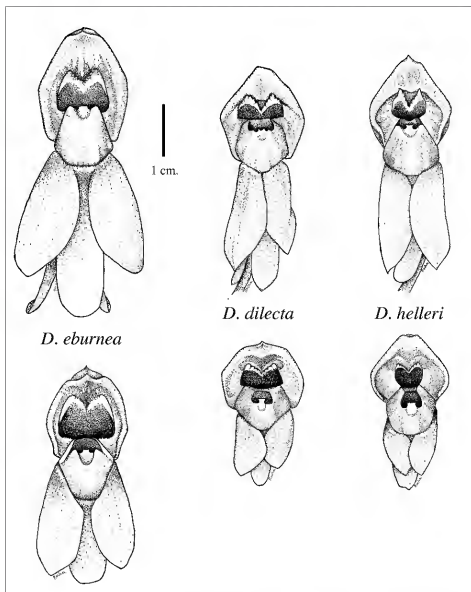


Figure 11. *Dressleria eburnea* (Rolfe) Dodson (*WM Whitten 1022*), *D. dilecta* (Rchb. f.) Dodson (*H G Hills 87179*), and *D. helleri* Dodson (*H G Hills 87178*). These three species are sympatric in the Sarapiquí River Valley, Costa Rica. Each produces a unique fragrance. Drawing by Omar E. Rocha G.



**Distribution:** Nicaragua and Costa Rica.

Additional specimens examined. **NICARAGUA:** Dept. of Jinotega, coffee plantation at the base of Peñas Blancas, alt. 915 m, Jun 1965, *A. H. Heller 7094* (SEL); Dept. of Chontales, Babilonia Mine, 570 m, Sept (without year), *A. H. Heller 6972* (SEL); Dept. of Zelaya, Cerro Saslaya, cloud forest, 1100 m, 3 May 1978, *D.A. Neill 3838* (MO). **COSTA RICA:** Many plants were collected Prov. of Heredia, along Rt 9 at km 47, Sarapiquí River Valley, Mar 1986, Hills, Whitten & Ballestara, ex hort. F1044, 20 Feb 1987, *H.G. Hills 87178* (AMES); 29 Oct 1987, *H.G. Hills 87145* (FLAS); 10 Jun 1990, *H.G. Hills 90018* (NCU, K in spirit); 09 Jun 1991, *H.G. Hills 91707* (AMES); 09 Jun 1992, *W.M. Whitten sn* (FLAS); ex hort F1047, 29 Nov 1987, *H.G. Hills 87181* (SEL); ex hort. F1046, 5 Jul 1988, *W.M. Whitten s.n.* (SEL); ex hort. F1087, 1 Jul 1988, *W.M. Whitten 1018* (FLAS, ); 03 Jun 1991, *S.W. Ingram and Ugucioni 967*; without location, ex hort., *F.L. Stevenson 61069* (SEL spirit #4526); without location, ex hort. MO 60-9-77 (SEL spirit #4184); without location, Lankester, ex hort. K 434-1959 (K).

The flower buds of *Neill 3838* are so immature as to render a positive identification impossible. Because of the proximity in collection locale to the other Nicaraguan material, and characteristics of the inflorescence, the collection has been annotated as *Dressleria helleri*. Given this interpretation, there are no authenticated specimens of *D. dilecta* known from Nicaragua.

**Etymology:** The species honors the late Alfonse Henry Heller (1894-1993), an avid orchid enthusiast who contributed substantially to our knowledge of Nicaraguan orchids.

**Fragrance:** Dominated by beta ocimene and p-dimethoxybenzene.

**Pollination:** The pollination observations of Dressler, cited by Dodson (1975), are actually those for *Dressleria kerryae*.

9. **DRESSLERIA KALBREYERI** H.G. Hills, Lindleyana 15:173. 2000. **TYPE:** COLOMBIA. Norte de Santander, vicinity of Ocaña, Jan 1878, *Kalbreyer 504* (holotype: W; isotype: AMES). Fig. 12.

**Pseudobulbs** fusiform to 10 cm tall, 2–3 cm wide. **Leaves** to 45 cm x 6 cm. **Inflorescence** basal, loosely flowered raceme, to 30 cm. **Pedicels** to 4 cm. **Flowers** nonresupinate, saccate. **Sepals** 18 mm long, 5.5 mm wide. **Petals** 17 mm long, 10 mm wide. **Lip** 15 mm long, 10 mm wide, adnate to the bottom third of the column. Apex half of the lip flat or slightly reflexed. Entrance to the saccate portion of the lip a slit partially hidden behind the column, 3.5 mm wide at the base of column, 7 mm wide at the top, 2 mm high. **Callus** not well defined, a low mound. **Column** 6 mm long, 6–7 mm wide at base. **Fruit** not seen.

*Dressleria kalbreyeri* may be distinguished by its narrow, transverse opening to the sac that is partially concealed by the column and by the small flowers with narrow sepals.

**Distribution:** Northeastern Colombia and western most Venezuela.

Additional specimens examined. **COLOMBIA:** Dept. of Meta, near Villa Vicencio, G *Escobar 496* (AMES); near Villa Vicencio, G *Escobar 532* (AMES). **VENEZUELA:** Edo. Tachira, Quebrada La Blanquita, near La Fundación, R. Mejía C. ex hort., Oct 1973, *Dunsterville 1295* (SEL spirit).

**Etymology:** The species is named for the collector of the type, Wilhelm (Guillermo) Kalbreyer (1847-1912).

**Fragrance:** Unknown

**Illustrations** Garay (1969) as *Catasetum dilectum*, Dunsterville and Garay (1976, 1979) as *Dressleria dilecta*, Romero and Carnevali (2000) as *Dressleria dilecta*.

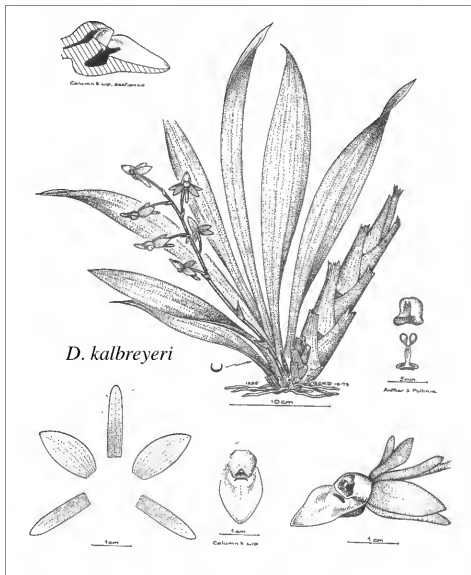


Figure 12. *D. kalbreyeri* H.G. Hills (R. Mejía C. s.n.). Drawing by G.C.K. Dunsterville.

**10. DRESSLERIA KERRYAE** H G Hills, Lindleyana 15:173. 2000. **TYPE: PANAMA.** Prov. Panama. Cerro Jefe, 27 May 1968, *R. L. Dressler 3515* (holotype: FLAS). Fig 13

**Pseudobulbs** fusiform to 10 cm, 2–3 cm wide. **Leaves** to 45 cm, to 6 cm wide. **Inflorescence** basal, arching, loosely flowered raceme to 35 cm. **Pedicle** to 4 cm. **Flowers** non-resupinate, longer than broad. **Sepals** 19–21 mm long, 6–7 mm wide strongly reflexed against the ovary. **Petals** 16–17 mm long, 10–11 mm wide strongly reflexed against the ovary. **Lip** 16–17 mm long, 10–11 mm wide. Top half of the lip flat or slightly reflexed. Callus of the lip elevated 3–4 mm to make the lip entirely adnate to the column. Opening to the sac is small and nearly rectangular, 2.0–3.5 mm high, 1.5–2.0 mm wide. Margin of the opening entire. **Column** 8–8.5 mm long, 8–8.5 mm wide at base. **Fruit** not seen.



Figure 13 *Dressleria kerryae* H G Hills (*A. Niessen s.n.*). Photo by Juan Carlos Uribe.

*Dressleria kerryae* has been confused with *D. helleri* (e.g., the illustration in Dodson [1975] is *D. kerryae* and not *D. helleri*) and differs from the latter by having an entire opening to the lip unlike the erose margin of *D. helleri*. *Dressleria kerryae* is most similar to *D. severiniana*, differing by the shape and size of the opening to the sac. In *D. kerryae* the opening is elongate and nearly twice as long as broad. In *D. severiniana* the opening is nearly square. The elevation of the callus from the plane of the lip is more than twice that of *D. severiniana*.

I have annotated *Cuatrecasas 14981* as *Dressleria kerryae* although the flowers are not fully developed. In addition, G. Gerlach (pers. comm.) has material of *D. kerryae* collected in the province of Choco, Colombia (cultivated at HEID, acc. #0-19206). Additional collections from the Pacific slope of Colombia will help to clarify the range of the species.

**Distribution:** Eastern Panama and Pacific slope of Colombia.

Additional specimens examined. PANAMA: Prov. Panama, Cerro Jefe, 1968, Dodson & Dressler, same field collection as the holotype, ex hort. UM 12-68-1, 11 June 1968, *H.G. Hills 68101* (AMES spirit, K spirit, SEL spirit #4531); El Llano-Carti Road, 1976, N.H. Williams, ex hort. MSBG 1976-56-8, 10 May 1978, *Pridgeon s.n.* (SEL); 10 km north of Margarita on road to Madroño, 550 m, 31 Jan 1979, *Hammel 6017* (MO). COLOMBIA: Dept. Valle del Cauca, Cordillera Occidental, Hoya del Río Digua, Piedra de Moler, 19-28 Aug 1953, *Cuatrecasas 14981* (AMES); west of Calima Lake near Río Bravo, 2001, *A. Niessen s.n.* (SEL spirit).

**Etymology:** The species name honors Kerry Dressler (1947-), wife of Robert Dressler.

**Franchise:** 1,8 cineole and p-dimethoxy benzene.

**Illustrations:** Dodson (1975) figure 1D as *Dressleria helleri*; Misas Ureta (2006) as *D. helleri*.

**Pollination:** Dodson (1975) reported that Dressler observed flower visitation on Cerro Jefe, type locality of the species. Dressler (pers. comm.) has updated the information and reports *Eufrestia anisoclora*, *Eufrestia schmidtiana*, *Euglossa asarophora* and *Euglossa championi* with *Dressleria* pollinaria. Dressler (pers. comm.) has collected *Euglossa ignita* from Bahía Solano, Choco, Colombia with *Dressleria* pollinaria that presumably are of this species.

#### 11. DRESSLERIA SEVERINIANA H.G. Hills, Amer. Orchid Soc. Bull. 60:616. 1993. TYPE:

PANAMA. Prov. Coclé, El Valle de Anton, R. L. Dressler, sin. dat., ex hort. F1757, 12 May 1990, *H.G. Hills 90015* (holotype: AMES [not yet sent]; isotype: K spirit). Figs. 14 & 15.

**Pseudobulbs** fusiform to 12 cm. **Leaves** to 45 cm, to 6 cm wide. **Inflorescence** basal, loosely flowered raceme to 30 cm. **Pedicel** to 3.5 cm. **Flowers** non-resupinate, elongate. **Sepals** 21–23 mm long, 5–6 mm wide strongly reflexed against the ovary. **Petals** 17–18 mm long, 10–12 mm wide strongly reflexed against the ovary. **Lip** 17–18 mm long, 11–12 mm wide, apical half of lip flat or slightly reflexed; callus of lip elevated 1.5 mm making the lip entirely adnate to column; opening to the sac nearly square, 4.5 mm high, 4.5 mm wide; margin of opening to the sac a thin flap of tissue. **Column** 7.5–8 mm long, 8–9 mm wide at base. **Fruit** not seen.

*Dressleria severiniana* has been consistently misidentified as *D. dilecta* that differs by the shape of the lip opening and inflorescence. In *D. severiniana* the opening is nearly square with an almost entire margin whereas *D. dilecta* lip opening has an erose margin. The inflorescence of *D. severiniana* is a loosely flowered raceme, unlike the densely flowered, subcapitate inflorescence of *D. dilecta* with overlapping flowers.

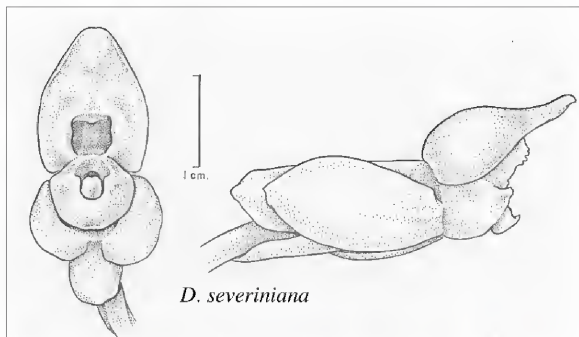


Figure 14. *Dressleria severiniana* H.G. Hills. Drawing of the holotype (ex hort. F1757 H.G. Hills 90015) by Bobbi Angell



Figure 15. *Dressleria severiniana* H.G. Hills (ABG 20020113). Photo by Danny Lentz. The plant is growing at the Atlanta Botanical Garden

The placement of *Allen 4565*, consisting solely of flowers in spirit and a photograph, is problematic and it may represent a hybrid with *Dressleria dilecta* or else is an undescribed species. No additional material is known. It is hoped with publication of the photo (Fig. 19), that additional material will be found. Allen's description in the Orchids of Panama appears to have been taken from the description of *Catasetum suave* and not a description of his specimen 4565. Allen (1949) clearly states that neither of his specimens agrees with *C. dilectum*.

**Distribution:** Panama.

Additional specimens examined. PANAMA: Prov. Cocle, El Valle de Anton, R.L. Dressler, ex hort. F1756, 28 May 1987, *H.G. Hills 87180* (AMES, SEL); El Valle de Anton, R. L. Dressler, ex hort. F1757 same plant as holotype, 10 May 1990, *H.G. Hills 90015* (K in spirit); 09 May 1991, *H.G. Hills 91014* (NCU) 30 May 1992, *H.G. Hills 92004* (AMES, SEL); 07 May 1996, *W.M. Whitten 3603* (FLAS); El Valle de Anton, César Barsallo ex hort. *Dressler s.n.* (FLAS); El Valle de Anton, 9 Jan 1972, *A. Gentry & J. Dwyer 3681* (MO); Prov. Veraguas, Cerro Tuté region west of Santa Fe, 915m, *P.H. Allen 4565* (AMES spirit #P2723).

**Etymology:** The species name honors Lil Severin (1905-1998), who had been a long term AOS judge from Cupertino, California.

**Fragrance:** 1,8-cineole, phenyl ethyl alcohol, methyl salicylate and phenylethyl acetate.

**12. DRESSLERIA WILLIAMSIANA** H.G. Hills, *sp. nov.* TYPE ECUADOR. Prov. Esmeraldas; Agave plantation off road from Lita to Cachaco Aug. 1987, Whitten *et al.* ex hort. F87038, 6 Feb 1989, *W.M. Whitten s.n.* (holotype: MO). Figs. 16, 17 & 18.

*Dressleria williamsiana* is most similar to *D. bennettii* but differs by the location and the shape of the callus. In *D. williamsiana* the callus is tongue like extending from the tooth of the transverse narrow opening of the lip to the apex of the lip unlike the triangular callus of *D. bennettii*. Callus on the sides of the opening not prominent as with *D. bennettii*. The presence of the tongue-like callus and narrow transverse opening distinguishes *D. williamsiana* from *D. fragrans*.

**Epiphyte** with basal thickly vermiform roots. **Pseudobulbs** fusiform-cylindric, 6–12 cm tall, 2–4 cm wide, fleshy, concealed by persistent leaf bases. **Leaves** oblong-lanceolate, up to 35 cm long, 6 cm wide, acute, persistent, alternate, distichous, prominently veined abaxially. **Inflorescence** a basal arching loosely flowered raceme to 35 cm long. **Pedicels** to 4 cm long. **Flowers** nonresupinate, greenish white turning yellow with age, fleshy, strongly fragrant. **Sepals** lanceolate, acute, dorsal sepal to 26 mm long, 6.5 mm wide, reflexed along the ovary; lateral sepals lanceolate, obtuse, strongly divergent, to 25 mm long, 6.5 mm wide. **Petals** ovate, acute, to 23 mm long, 12 mm wide. **Lip** uppermost, elliptic-ovate, acute, saccate, adnate to the basal third of the column, to 20 mm long, 14 mm wide; sac transverse, obscurely 2-lobed, opening of the sac transverse, narrow hidden by the column. **Tongue** like callus extending from tooth in the opening of the sac to the apex of the lip. **Column** to 6 mm long, to 9 mm wide at base. **Pollinia** 2, borne on a common stipe and viscidium. **Fruit** not seen.

**Distribution:** Known only from northwestern Ecuador but likely occurs in southwestern Colombia.

Additional specimens examined. ECUADOR: Prov. Esmeraldas; Agave plantation off road from Lita to Cachaco Aug. 1987, Whitten *et al.*, same field collection as the holotype, flowered at Harvard, 1 Oct 1989, *G. Romero 2031* (AMES photo & spirit); Cristal, 10 km southwest of road from

Lita to Alto Tambo beginning at km 4. 1400-1500 m, ex hort. Rio Palenque Science Center, 10 July 1989, C.H. Dodson & A. Gentry 17655 (MO).



Figure 16. *Dressleria williamsiana* H.G. Hills (*Whitten et al.*). Plant from the same field collection as the holotype, flowered at Harvard. Photo by Gustavo A. Romero.



Figure 17. *Dressleria williamsiana* H.G. Hills. Close view showing narrow opening of the sac. Photo by Gustavo A. Romero.

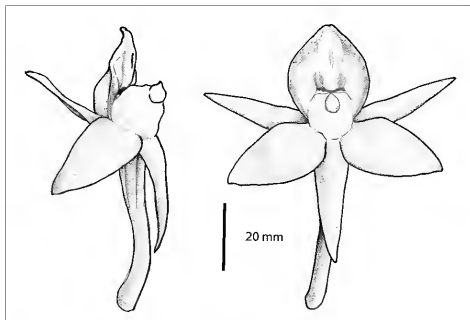


Figure 18 *Dressleria williamsiana* H.G. Hills. Drawing by Alfonso Doucette

**Etymology:** The species name honors Norris H. Williams, who has spent much of his professional career in the study of Orchidaceae. His work spans a multitude of disciplines, from floral fragrance analysis to molecular systematics to field biology. He was an important part of the field team that discovered this species.

**Franchise:** methyl salicylate.

*Dressleria williamsiana* should not be confused with "*D. williamsii*," an unpublished name assigned to specimens of *D. kerryae*.

#### SUMMARY AND CONCLUSIONS

Like many people who have submitted a revision, I can assure you this is not the last word. There is considerable variation in what I have called *Dressleria dodsoniana*. There have been no recent collections of *D. eburnea* in South America and since the holotype was made from a cultivated plant, the origin of the plant being from Colombia probably is in error. None of the collections from South America matches the description of *Dressleria eburnea* and six new species have been named. They are *D. aurorae*, *D. bennettii*, *D. dodsoniana*, *D. fragrans*, *D. kalbryeri*, and *D. williamsiana*. None of the material originating from Panama has been shown to be *Dressleria dilecta* or *D. helleri* and three new species have been named: *D. severiniana*, *D. kerryae*, and *D. allenii*. There is also a plant collected once in western Panama by Paul H. Allen (Fig. 19) that may be a hybrid or a new species that does not represent *Dressleria dilecta* or *D. severiniana*. The material from west of Cali, Colombia (Fig. 20) is clearly a new species but no herbarium material exists and no recent collections have been made.





Figure 19. *Dressleria* sp. or a natural hybrid? Allen 4565. Photo by Paul H. Allen



Figure 20 *Drexleria* species Pacific slope of Colombia west of Cali Photo by Juan Carlos Uribe

#### ACKNOWLEDGEMENTS

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## A NEW SPECIES OF *CARDAMINE* (BRASSICACEAE) FROM SOUTH-CENTRAL TEXAS

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### ABSTRACT

A novel taxon, *Cardamine carriei* B.L. Turner, sp. nov., is described from the Edwards Plateau of south-central Texas (Uvalde and Kinney counties). It appears to belong to the *C. auriculata* complex (sensu Rollins 1940, 1993), having the fractiflex capitulescences of that assemblage, within which it most resembles *C. macrocarpa*, a species of trans-Pecos Texas and Coahuila.

**KEY WORDS:** *Cardamine macrocarpa*, Brassicaceae, Texas, Kinney County, Uvalde County, Kickapoo Cavern State Park

Identification of new collections of various taxa, especially in attempts to keep up-to-date my Atlas of Texas Plants (Turner et al. 2003), has occasioned the present paper.

**CARDAMINE CARRIEI** B.L. Turner, sp. nov. Fig 1. **TYPE:** USA. Texas. Kinney Co.: Kickapoo Cavern State Park, ca. 400 ft NW of BM 1822, ca. 1700 ft SE of windmill at BM 1717, SW  $\frac{1}{4}$  of park, 29° 35' 48" N, 100° 27' 25" W, clay loam and duff over rock rubble on slope at shaded base of NW-facing limestone bluff, 1700–1720 ft, 20 Apr 1990, *W.R. Carr 10,458* (holotype: TEX; isotype: TEX).

**Annual** herbs, glabrous, 10–20 cm high. **Taproots** slender, delicate. **Basal leaves** glabrous, mostly 3–6 cm long, not persisting; petioles 2–4 cm long; segments broadly ovate in outline, the terminal segment mostly 1.5–2.0 cm long, and as wide, 3-nervate from the very base, their margins irregularly lobate. **Cauline leaves** mostly 3–8, 5–8-foliolate, 6–10 cm long, 4–5 cm wide; petioles 3–4 cm long. **Inflorescence** mostly a weakly ebracteate, divaricately branched, terminal raceme 6–10 cm long. **Sepals** 4, lanceolate, glabrous, ca 2 mm long, 0.5 mm wide. **Petals** 4, white, linear, ca 2 mm long, 0.5 mm wide. **Stamens** 6 (4 long, 2 short); filaments (longer) ca 2 mm long, their anthers ca 0.75 mm long. **Capsules** glabrous, 3–4 cm long, 1.0–1.5 mm wide; pedicels 3–5 mm long. **Seeds** 20–25 per capsule, ovoid, tan, minutely rugose, ca 1.5 mm long, 1.0 mm wide.

Additional specimens examined. USA. Texas. **Kinney Co.:** Kickapoo Cavern State Park, E facing limestone slope in Pine Canyon, ca 2800 ft E of BM 1914 near S boundary of park, locally common, with *Poa bigelovii* and *Parietaria obtusa* in shallow clay loam and leaf litter under guajillo and pinyon pine, ca 1840 ft, 19 Apr 1990, *Carr 10,445* (TEX). **Uvalde Co.:** ca. 1.7 airmiles W of FM 2690 bridge, on the Annandale Ranch, 29° 26' 49" N, 99° 41' 33" W, 1260–1270 ft, 9 Apr 1997, *Carr 16050* (TEX); 3.4 airmiles S of low water crossing at Concan, 2.2 airmiles W to WSW of jct. FM 2759 and State Rte. 127, 29° 26' 48.4" N, 99° 41' 57.2" W, 1260 ft, 11 Apr 2007, *Carr 25737* (TEX); 0.2 mi past the entrance to the Wittig Ranch on the left side of road, 2 Feb 1987, *Wittig 7509* (TEX).

The species is named for the exceptional Texas botanist, William [Bill] R. Carr, well known for his carefully assembled specimens from throughout the state, including four of the five known collections of the new species.



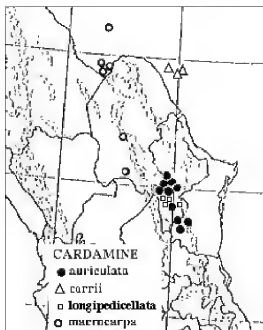


Figure 2. Distribution of the *Cardamine auriculata* complex

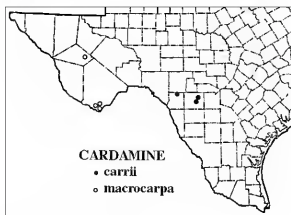


Figure 3. Distribution of *Cardamine carrii* and *C. macrocarpa* in Texas

*Cardamine carriei* presumably belongs to the *C. auriculata* complex of species (Fig. 3), all of which have fractiflex branching (sensu Rollins 1940). The following key to the complex should serve to identify the novelty:

1. Terminal leaflet much larger than the lateral leaflets; stems hirsute with trichomes 1–2 mm long ..... *Cardamine mexicana*
1. Terminal leaflet about equal to the lateral leaflets; stems glabrous, or nearly so.
  2. Petals emarginate; pedicels 1–2 cm long ..... *Cardamine longipedicellata*
  2. Petals entire, not emarginate; pedicels less than 1 cm long.
    3. Petals strap-shaped, 5–8 mm long, ca 1 mm wide; siliques ca 1.5 mm wide; pedicels 5–8 mm long ..... *Cardamine macrocarpa*
    3. Petals linear, ca 2 mm long, 0.5 mm wide; siliques 1.0–1.4 mm wide; pedicels 3–5 mm long ..... *Cardamine carriei*

Previous botanists, including Rollins (1993) and Turner et al. (2003), have identified *Cardamine carriei* as *C. macrocarpa* Brandegees var. *texana* Rollins (the type from Brewster Co., Texas). Al-Shehbaz et al. (2010) noted that "The characters by which var. *texana* is said to differ from var. *macrocarpa* are artificially drawn, and the style length, presence or absence of indumentum on the pedicels, and degree of flexuosity of the raceme rachises do not correlate and can vary within a given area. For these reasons, we do not recognize infraspecific taxa in *Cardamine macrocarpa*."

Al-Shehbaz et al. (2010) also noted that in the USA "*Cardamine macrocarpa* is known from the Chisos Mountains, Brewster County." A recent collection of the taxon, however, presumably not examined by the authors, has been collected from eastern Jeff Davis County, as indicated in Figure 2.

Jeff Davis Co. : on Nations Ranch, ca. 0.8–1.0 air miles SSW of summit of Bear Cave Mountain, rare in gravel and on rock outcrops ... rhyolite canyon at NE tip of Bear Mountain, ca. 5600–6000 ft, 31 Aug 1997, Carr 1492 (TEX)

Branching of the inflorescence of *Cardamine carriei* in early flower is not as fractiflex as occurs in *C. macrocarpa*, but more aged racemes are often considerably so (e.g., Carr 10445, 10458). At least one reviewer of the present paper suggested that the novelty might best be treated as but a variety of *C. macrocarpa*, but the distinctions of *C. carriei* from the latter are as distinct as those of yet other specific taxa of the *C. auriculata* complex, and I find no suggestion that the two taxa intergrade, much less grow together. In short, *C. carriei* is easily recognized by its distinctive foliage (larger leaves with fewer broader segments), fruits (slender, on short pedicels) and flowers (very small, the petals ca 2 mm long), and the distinctive soil and habitat of the Edwards Plateau.

So far as known, Al-Shehbaz et al. (2010) did not examine material of *Cardamine carriei*, none of the sheets on file at TEX having been annotated by the workers concerned.

*Cardamine carriei* is unlikely to be a weedy or introduced taxon (as the possibility occurred to me in my ignorance of the genus as a whole), since it occurs in natural habitats in association with the rare pine tree, *Pinus remota* (Little) Bailey & Hawksworth [Texas pinyon]. As noted by Little (1966), "the pinyons of Edwards Plateau [Edwards and Kinney counties] are relics of a more widespread pinyon-juniper woodland" dating back to Pleistocene times, and perhaps earlier. In the company of Jana Kos, I attempted to locate the novelty anew, but was unable to, largely because of its apparent rarity and my inability to negotiate the terrain sampled by Carr. Nevertheless, it was obvious from our field observations that *C. carriei* was nearly always associated with *Pinus remota* or its habitat.



## ACKNOWLEDGEMENTS

I am grateful to my colleagues Ihsan Al-Shehbaz and Mike Powell for helpful comments. Jana Kos helped in the field studies and edited the paper. Distribution maps (Figs. 2 and 3) are based upon specimens on file at SRSC and TEX.

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COMPOSITAE OF CENTRAL AMERICA-II  
*ORTIZACALIA* (SENECIONEAE: SENECTIONINAE),  
A NEW GENUS OF LIANAS WITH COMOSE STYLE BRANCHES

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ABSTRACT

*Ortizacalia* Pruski (Compositae: Senecioneae) is described as a new monotypic genus from Costa Rica and the combination *Ortizacalia austin-smithii* (Standl.) Pruski is made. *Ortizacalia* is diagnosed by its densely long-comose style branch apices with 15–20 penicellate papillae in a tuft twice the length of the branch diameter. *Ortizacalia* is placed in subtribe Senecioninae and compared to other regional genera of lianas of the subtribe.

**KEY WORDS:** Asteraceae, Compositae, Central America, Costa Rica, *Dresslerothamnus*, lianas, *Ortizacalia*, *Pentacalia*, Senecioneae, Senecioninae.

The new genus *Ortizacalia* Pruski (Compositae: Senecioneae: Senecioninae) from Costa Rica is described and compared to *Dresslerothamnus* H. Rob. and *Pentacalia* Cass., its close congeners. *Ortizacalia* keys to or near *Pentacalia* or species now referred to *Pentacalia* in the keys in Barkley (1975, 1985), Barkley et al. (1996), Cuatrecasas (1986), Díaz-Piedrahita and Cuatrecasas (1999), Janovec and Robinson (1997), Nordenstam (2007), Standley (1938), and Williams (1984). However, upon seeing an image of the comose style branches of *Ortizacalia*, Harold Robinson (pers. comm. IV-2012) commented that "nothing that looks like that has been called *Pentacalia* by either Nordenstam or myself." *Ortizacalia* is superficially similar to several of the vining West Indian senecioid genera treated by Nordenstam (1978, 2006, 2007), but in technical features matches none of them. *Dresslerothamnus*, *Ortizacalia*, and *Pentacalia* are each lianas with caudate anthers (Fig. 1) and senecioid microfeatures (Figs. 1–2) typical of subtribe Senecioninae (Nordenstam 1978; Wetter 1983; Pelsner et al. 2007; Pruski 2012), but *Ortizacalia* differs from the two others by densely long-comose style branch apices with penicellate papillae twice the length of the branch diameter (Fig. 2). Style branch characters have been used traditionally to distinguish genera of Senecioneae, and generally seem to be a reliable taxonomic character. For more than half a century *Ortizacalia*, by virtue of its cryptic early budding type collection, has flown under the taxonomic radar, but the recent rediscovery of this rare liana has allowed its distinctive characters to step to the fore.

ANATOMICAL AND SEM METHODS

The wet slide mounts were viewed on an Olympus compound microscope and photographed with a Canon A640 camera. SEM mounts were sputter-coated with Au/Pd on a Denton Desk V Cold Sputter Coater operating at 35 mAmps for 120 seconds and micrographed on a JEOL NeoScope JCM-5000 scanning electron microscope operating under high vacuum from 5–10 kV.

**ORTIZACALIA** Pruski, gen. nov. Figs. 1–5. **TYPE:** *Senecio austin-smithii* Standl. [= *Ortizacalia austin-smithii* (Standl.) Pruski].

Suffrutex volubilis; caules glabri vel distale puberuli; folia simplicia alterna petiolata, petiolo 0.8–2.5 cm longo, lamina 4–9 × 1–2.5 cm oblanceolata vel oblonga subcarnosa pinnatim venosa basi cuneata vel attenuata

marginē integra, capitulescentia 8–25 × 6–18 cm terminalis corymboso-paniculata, pedunculi 4–15 mm longi, capitula radiata 10–12 mm alta, involucrem 3.5–5(–6) mm diam cylindricum, phyllaria 8, 6–7.5 × 0.8–1.3 mm lanceolata glabra vel distale puberuli, flosculi radiati (0–)2–5, corolla luteola vel aurantiaca glabra, tubo 4–5.5 mm longo, limbo 5–8 × 0.8–1.2 mm longo 4-nervio, flosculi disci 10–16, corolla 8–9.5 mm longa infundibuliforma luteola glabra, tubo et limbo subaequalia, lobis circiter 1.5 mm longis lanceolatis, antherae circiter 2.5 mm longae caudatae, collum basi dilatatum, styli rami 1.3–1.7 mm longi valde et longe comosi, areis stigmaticis discretis, cypselae 1.3–2 mm longae circiter 5-costatae glabrae, setae pappo 7.5–8.5 mm longo.



Figure 1. Anthers of *Ortizacalia austini-smithii* showing balusterform (dilated) anther collars that are a diagnostic subtribal feature of subtribe Senecioninae. A Individual anther abaxial face showing ovate anther appendage, caudate theca, and balusterform anther collar. B Abaxial close-up showing caudate anther thecae and balusterform anther collars. C Medial adaxial endothecial tissue with transitional cell wall thickenings (Haber & Zuchowski 9847, MO). [Scale bars: A, 0.5 mm, B, 0.1 mm, C, 20  $\mu$ m.]

**Scandent to climbing subglabrous woody vines**, flowering branches pendent, stems subterete, few-branched distally, griseous-ochraceous, glabrous proximally, puberulent distally, leafy distally, distal internodes shorter than leaves, bark smooth, pith solid, herbage when pubescent with simple trichomes. **Leaves** simple, alternate, petiolate, petiole slender, exalate, blade oblanceolate to oblong, subcarnose, venation pinnate, secondary veins neither impressed nor prominent, margins entire, surfaces glabrous, eglandular. **Capitulescence** (Fig. 4) corymbiform-paniculate, pluricapitulate, terminal on main axis or on elongated lateral branches much longer than subtending leaves, branch axis neither foreshortened below nor within capitulescence, proximal and mid-capitulescence branches typically subtended by subsessile leafy bracts, distal branchlets few-bracteolate, thinly crisped-puberulent, ultimate clusters of capitula rounded, peduncles erect, thinly crisped-puberulent, 1–few-bracteolate. **Capitula** (Fig. 5) short-radiate, usually 12–21-flowered, involucre cylindrical, irregularly and loosely calyculate, phyllaries 8, 1-seriate, free, indistinctly imbricate, venation of green midzone indistinct, mostly glabrous but apex usually puberulent, phoranthium (receptacle) flat, epaleate, crestate, solid (Fig. 3A). **Ray florets** pistillate, corolla yellow to orange, glabrous, limb slightly exserted, lanceolate to elliptic-lanceolate, 4-nerved, apex 3-denticulate, style rarely trifid, but when trifid each of the three branches equally comose. **Disk florets** bisexual, longer than to much longer than involucre, corolla funnelliform, yellow, glabrous, 5-lobed, tube and limb subequal, lobes triangular-lanceolate, shorter than throat, spreading to recurved,

apex papillose; anthers (Fig. 1) yellow to orangish, collar balusterform (distal cells somewhat quadrangular and basal cells bulbous to nearly isodiametric), theca base caudate, tails shorter than collar, endothelial tissue transitional with both vertical and horizontal cell walls irregularly thickened, apical appendage ovate, rounded apically, style base abruptly dilated, branches (Fig. 2) spreading to recurved, distal half of abaxial surface rough and densely papillose with ovoid-obovoid apically obtuse-rounded papillae, subapically with dense semicircle of long papillae spreading at about 45°, branch apex rounded, densely long-comose with 15–20 pericellate whitish papillae in a tuft about twice as long as branch diam., pericellate papillae stiffly erect with acute apex, stigmatic surface 2-banded. **Cypselae** (Fig. 3B) tardily maturing, subcylindrical, subprismatic, ca. 5-ribbed, glabrous, carpodium distinct, with a distal rim, pappus bristles of rays and disks similar, 1-seriate, white, barbellate, reaching to about the base of the disk corolla lobes.

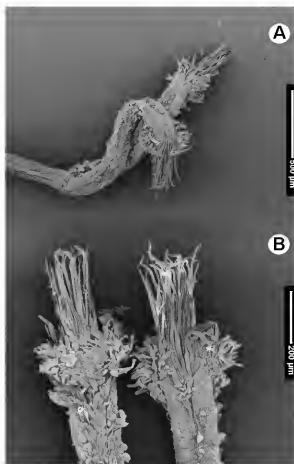


Figure 2. Apically comose style branches of *Ortizacalia austro-smithii* showing 2-banded stigmatic surfaces characteristic of subtribe Senecioninae. A. Branches showing the strongly papillose abaxial distal half of branch (left center) and apical comae. B. Close-up of abaxial surface (left) showing the densely pericellate-papillose apical coma, the subapical semicircle of long papillae, and at the bottom of the image the dense papillae of the distal half of branch, and adaxial branch surface (right) showing the pericellate-papillose apical coma, the lateral margins of the subapical-abaxial semicircle of long papillae, and at the bottom of the image the distal portion of the 2-banded stigmatic surfaces. (Haber & Zuchowski 9847, MO).

**Etymology.** I am very pleased to dedicate *Ortizacalia* to my fiancée, Dra. Rosa del Carmen Ortiz, in recognition of her keen eye and helping hand in the field, herbarium, and lab. Although while collecting Rosita is invariably in a monospermiana mand-set, she has pointed out to me many composites, including *Pentacalia* vining in the forest of Peru, where she is most at home. *Ortizacalia* is so named also to draw attention to its relations to *Pentacalia*, and follows a string of generic names of Senecioneae using the suffix of *Cacalia*, which includes *Digitacalia* Pippen, *Koyamacalia* H. Rob. & Brettell, *Miricacalia* Kitam, *Monticacalia* C. Jeffrey, *Synacalia* H. Rob. & Brettell, and *Talamancalia* H. Rob. & Cuatrecasas.

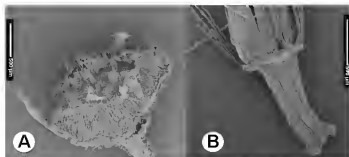


Figure 3. *Ortizacalia austriacantha*. A. Longitudinal section through a capitulum (with all phyllaries removed except for the base of one phyllary on the left) showing the solid (non-fistulose) pappus (foreground) with crests on top. The peduncle is towards the lower right. B. Disk corolla base and cypselae showing the 1-seriate pappus and the distally rimmed carpophodium. (A. Haber 11046, MO; B. Haber & Zuchowksi 9847, MO)

*Ortizacalia*, by its vining habit, simple leaves, caudate anthers (Fig. 1A–B), crestate solid pappus (Fig. 3A), and seneciooid macrofeatures (Figs. 1–2), is similar to *Dreslerothamnus* and especially to *Pentacalia*. *Dreslerothamnus* differs from *Ortizacalia* and *Pentacalia* by branched (vs. simple) trichomes, finely ca. 10- (vs. ca. 5-) ribbed tardily maturing cypselae, and when radiate by filiform (vs. usually lanceolate to elliptic) ray corolla limbs. *Ortizacalia* and *Pentacalia* have similar ca. 5-ribbed cypselae with well-defined carpophodia (Fig. 3B), but in their style branch ornamentation (Fig. 2) they differ by an order of magnitude. Robinson and Cuatrecasas (1978) describe the style branches of *Pentacalia* as “without distinct central coma of hairs” and commented that *P. matagalpensis* H. Rob. has unusually prominent distal style papillae. However, the styler papillae of *P. matagalpensis* are about 0.1 mm long and very much shorter than the branch diameter. Pelsner et al. (2007) found *Pentacalia* s. str. to be monophyletic and sister to shrubby *Serabacna* Cass. and the *Monticacalia vacuoides* (Kunth) C. Jeffrey group, but neither Central American species of *Pentacalia* nor *Dreslerothamnus* was not sampled by them.

*Ortizacalia* differs from *Dreslerothamnus*, *Pentacalia*, and other neotropical seneciooids by its rounded style branches that (1) in their abaxial distal half are markedly roughened and densely papillose with ovoid-obovoid apically obtuse-rounded papillae and (2) are densely long-comose tufted apically with 15–20 stiffly erect narrowly pectinate acute-tipped papillae about twice as long as branch diameter (Fig. 2). The apical style branch papillae in *Ortizacalia* (along with those of the otherwise dissimilar southern South American *Graphistylis* B. Nord. and *Jocenes* B. Nord. s. str.) are proportionally among the longest in the Senecioneae. Other regional genera with apically pointed



Figure 4. *Ortizacalia austin-smithii* showing stems straight to slightly curved distally and some budding capitula that match those of the type collection. (Unmounted duplicate of Estrada *et al.* 372).

styles are either filiform-style branched (e.g., *Crassocephalum* Moench and *Gynura* Cass.), herbs or shrubs with a moderate apical style branch coma (e.g., *Arbelaezaster* Cuatrec., *Garcibarrigoa* Cuatrec., *Jacmaria* B Nord., *Jessea* H Rob. & Cuatrec., and *Takamancalia* H Rob. & Cuatrec.), or have styles triangular-tipped and only moderately papillose (e.g., *Oklfeltia* B Nord. & Lundin and *Pseudogynoxys* (Greenm.) Cabrera). None of these genera with pointed styles comprise woody vines with tailed anthers as do *Dresslerothamnus*, *Ortizacalia*, and *Pentacalia*. A few other regional Senecioneae have elongate-tipped styles (e.g., *Gynoxys* Cass.), but are members of subtribe Tussilagininae.

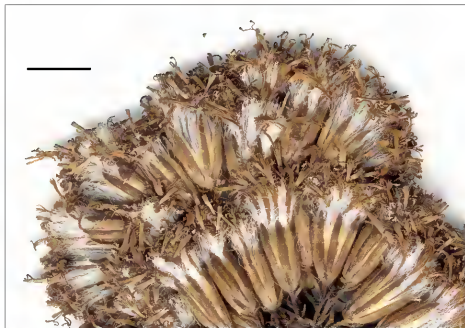


Figure 5 *Ortizacalia austin-smithii*. Close-up of capitula at anthesis (Haber 11046, MO) [Scale bar = 5 mm.]

**ORTIZACALIA AUSTIN-SMITHII** (Standl.) Pruski, comb. nov. Figs 1–5. *Senecio austin-smithii* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 22: 128, 1940. TYPE: COSTA RICA. Alajuela. Palmira, 1890 m [as 6200 feet], 9 Feb. 1938, *Austin Smith H299* (holotype: F, photo in MO, isotype: MO).

**Liana** climbing 1.6–5+ m into tree crowns, with 1–3 m long pendant flowering branches, stems straight to slightly curved distally (Fig. 4), leaf scars ca. 2 mm diam., raised. **Leaves** petiole 0.8–2.5 cm long, blade 4–9 × 1–2.5 cm, secondary veins usually 3–4, thin, straight, at ca. 45° to midrib, third order veins indistinct, base cuneate to attenuate, margins sometime slightly revolute, apex usually obtuse to rounded, adaxially subnitidous. **Capitulescence** 8–25 × 6–18 cm, 30–100+ capitulate, proximal and mid-capitulescence leafy bracts 2–3 × 0.4–1 cm, narrowly oblanceolate, glabrous, distal branchlet bracteoles 0.5–1 cm long, lanceolate, sessile, subglabrous to thinly puberulent, peduncles 4–15 mm long, bracteoles 1–2 mm long, linear-lanceolate, sessile. **Capitula**

10–12 mm tall (Fig. 5), involucre 3.5–5(–6) mm diam., phyllaries 6–7.5  $\times$  0.8–1.3 mm, lanceolate, inner ones with narrowly scarious margins 0.2–0.4+ mm diam., narrower than green midzone, cristae on phoranthium (receptacle) 0.2–0.4 mm long. **Ray florets** (0–)2–5, corolla tube 4–5.5 mm long, limb 5–8  $\times$  0.8–1.2 mm, subequal to or slightly longer than tube. **Disk florets** 10–16, corolla 8–9.5 mm long, tube 4–5 mm long, throat 2.5–3 mm long, lobes ca. 1.5 mm long, anthers (including appendage but not collar) ca. 2.5 mm long, collar 0.4–0.5 mm long, tails 0.2–0.3 mm long, apical appendage 0.4–0.5 mm long; style basal node 0.4–0.5  $\times$  ca. 0.3 mm, branches 1.3–1.7 mm long, apical coma papillae 15–20, 0.3–0.4 mm long. **Cypselae** (immature) 1.3–2 mm long, glabrous, carpodium ca. 0.2 mm, pappus bristles 7.5–8.5 mm long.

**Specimens examined:** COSTA RICA. **Alajuela.** Palmira, 1890 m, 9 Feb 1938, *Austin Smith* H299 (holotype, F, isotype MO). **Heredia.** Cordillera Central, San José de la Montaña, Paso Llano, 10° 04' 48" N, 84° 06' 36" W, 1900 m, 11 Feb 1995, *Estrada et al.* 372 (INB, MO + 1 unmounted duplicate, Fig. 4). **Puntarenas.** Monteverde, Pacific slope, moist forest patches and farms, 10° 18' N, 84° 48' W, 1300–1400 m, 5 Apr 1990, *Haber & Zuchowski* 9847 (MO), Cordillera de Tilarán, Monteverde, Pacific slope, farms and forest patches around community, 10° 18' N, 84° 48' W, 1400 m, 7 Mar 1992, *Haber* 11046 (CR, MO).

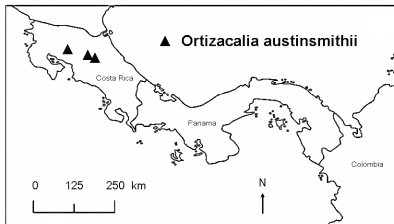


Figure 6. Distribution of *Ortizacalia austinsmithii*.

**Distribution and ecology.** *Ortizacalia austinsmithii* is a rare Costa Rican forest liana occurring mainly in the northwestern Pacific slope portion of the Cordillera de Tilarán near Monteverde (Prov. Puntarenas), eastwards into the Cordillera Central in Prov. Alajuela near Palmira about 15 km west of Volcán Poás, and in Prov. Heredia where its southeastern-most known station is about 8 kilometers south of Volcán Barva (Fig. 6). *Ortizacalia austinsmithii* occurs from 1300–1900 meters elevation at four localities within about 80 km of each other, and the four collections known to me show that this taxon is in bud and early flower in February and reaches anthesis in March and April.



The type collection is mostly in bud with few florets approaching anthesis, and for a long time I simply presumed this liana was a *Pentacalia*. The more recent collections afford sufficient material for comparative dissections, which show that the budding type, through the linking, early flowering *Estrada et al.* 372 (Fig. 4), can be matched satisfactorily to the two mature collections cited here that voucher the plates of microcharacters of flowering capitula.

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## JUSTIFICATION FOR SUBSPECIES IN *ARCEUTHOBIUM CAMPYLOPODUM* (VISCACEAE)

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### ABSTRACT

In the dwarf mistletoes (*Arceuthobium*, Viscaceae), sect. *Campylopoda* was previously considered to include entities treated at the rank of species: *A. abietinum*, *A. apacheum*, *A. blumeri*, *A. californicum*, *A. campylopodum*, *A. cyanocarpum*, *A. laricis*, *A. littorinum*, *A. microcarpum*, *A. monticola*, *A. occidentale*, *A. siskiyouense*, and *A. tsugense*. Morphology, host associations, levels of sympatry and genetic evidence are reviewed here and, in contrast, it is concluded that these taxa are best viewed as ecotypes of a single variable species. Formal nomenclature treating these taxa at the rank of subspecies is presented, following previous conventions for recognizing infraspecific taxa in dwarf mistletoes.

**KEY WORDS:** *Arceuthobium campylopodum*, dwarf mistletoe, ecotype, subspecies, Viscaceae

*Arceuthobium* (dwarf mistletoes, Viscaceae) has been of great interest to American plant morphologists, pathologists, and systematists since the late 1800s. This is the only genus in Viscaceae that naturally occurs in both the Old and New World. In contrast to most viscaceous mistletoes such as *Viscum* and *Phoradendron*, *Arceuthobium* is morphologically reduced with scale leaves (squamate habit) and small monochlamydeous flowers whose morphology varies little between species. The explosively dehiscent fruits are unique in the family and allow population expansion without requiring bird vectors. The adult shoots produce only a small amount of carbohydrate through photosynthesis, thus these mistletoes approach the holoparasitic condition (Nickrent & García 2009).

Dwarf mistletoes are often referred to as being host specific. In reality, host specificity varies tremendously among different species. In a broad sense, all New World dwarf mistletoes are more specific than their Old World counterparts because they occur only on Pinaceae whereas the latter parasitize both Pinaceae and Cupressaceae.

The taxonomy of American dwarf mistletoes has experienced many changes since the early 1900s. Gill (1935) applied a host form concept such that *Arceuthobium* names were determined by the host being parasitized. That method introduced problems when one dwarf mistletoe species occurred on several hosts and had to be given different names. The first comprehensive monograph of *Arceuthobium* was by Hawksworth and Wiens (1972). They rejected the host form concept, stating that the morphological integrity of mistletoe species was maintained even when it was found on non-principal hosts. This basic tenet was retained in the newer monograph (Hawksworth & Wiens 1996), which included descriptions of several new species.

Certainly one of the more taxonomically difficult groups in the genus *Arceuthobium* is a complex centered around *A. campylopodum*. In the 1972 monograph (Hawksworth & Wiens 1972), sect. *Campylopoda* Hawksw. & Wiens included 16 species in three Series. In the later monograph, a revised classification of the genus was proposed based upon DNA evidence (Chapter 15, Molecular

Systematics, Nickrent 1996). Here, taxa in series *Rubra* and *Stricta* from Hawksworth and Wiens (1972) were removed from sect. *Campylopoda* and placed in sect. *Vaginata*. This move was supported by molecular as well as morphological and biogeographic data. The newly constituted sect. *Campylopoda* was then essentially the same as series *Campylopoda* from Hawksworth and Wiens (1972) and included the following ten species: *A. abietinum*, *A. apachecum*, *A. blumeri*, *A. californicum*, *A. campylopodium*, *A. cyanocarpum*, *A. laricis*, *A. microcarpum*, *A. occidentale*, and *A. tsugense* as well as three more recently named species: *A. littorum*, *A. monticola*, and *A. siskiyouense*.

Although the above classification utilized data from nuclear ribosomal ITS sequences, sampling was incomplete (no Old World taxa were sampled) and included only four species from sect. *Campylopoda* (*A. abietinum*, *A. apachecum*, *A. campylopodium*, and *A. microcarpum*). This situation was rectified by Nickrent et al. (2004), where ITS sequences were obtained from all species in the genus as well as chloroplast *trnL* region sequences from New World species. The resulting ITS maximum parsimony tree showed that all but one of the 13 species of sect. *Campylopoda* had identical to nearly identical ITS sequences. The most genetically divergent member, *A. blumeri*, was considered to be a “transitional” species between the mainly USA sect. *Campylopoda* species and the mainly Mexican and central American subg. *Vaginata* species (Nickrent et al. 2004). The results from analyzing the chloroplast sequences were the same as with ITS. The high genetic similarity seen between species in sect. *Campylopoda* contrasted with values seen between other species in the genus where a greater number of substitutions was observed (longer branches on phylograms). For these reasons, a phylogenetic classification was proposed where all 13 species were considered to be part of a more broadly defined *A. campylopodium*.

#### Species concepts and *Arceuthobium* sect. *Campylopoda*

The species problem has been the focus of much discussion and conflict in the biological and philosophical literature. Species concepts include the biological, morphological, evolutionary, phylogenetic, and ecological, where each focuses upon different aspects of a broad spectrum of interrelated attributes and processes. Proponents of one or another concept often have specific requirements and objectives. From a philosophical perspective, Pigliucci (2003) discusses how “species” is a family resemblance (cluster) concept that can only be defined by a series of characteristics. Hawksworth and Wiens (1972, 1996) maintained that species of sect. *Campylopoda* could be distinguished by morphological characters (e.g. shoot dimensions, shoot color, width of the staminate flower, etc.), physiological characters (flowering and fruiting times), as well as principal host species. The purpose of this article is to examine some of the empirical evidence that bears upon a meaningful species concept for the *Arceuthobium campylopodium* complex.

**Morphological differentiation.** The monograph by Hawksworth and Wiens (1996) reported quantitative (continuous) morphological characters for all 13 members of sect. *Campylopoda*, and five of the characters used are depicted graphically in Figure 1. It should be stated that no sample sizes nor variances in the measurements were reported. Looking at the first four characters, although the mean values differ between some taxa, there is much overlap in the numerical ranges. There appears to be very little variation in staminate flower width between the taxa. To date no multivariate studies have been conducted to determine whether the characters used to differentiate species in sect. *Campylopoda* are statistically valid.

**Reproductive isolation.** The biological species concept (Mayr 1942) emphasizes reproductive isolation. In plants, reproductive isolating mechanisms may evolve because of geographical isolation, ecological niche segregation, temporal variation in flowering times, behavioral traits of pollinators (ethological differences), and genetic (e.g. interspecific incompatibility) factors. Hawksworth and Wiens (1972, 1996) indicated that there is no evidence of hybridization between any species of *Arceuthobium*. But detecting hybridization would be difficult because all members of the genus have

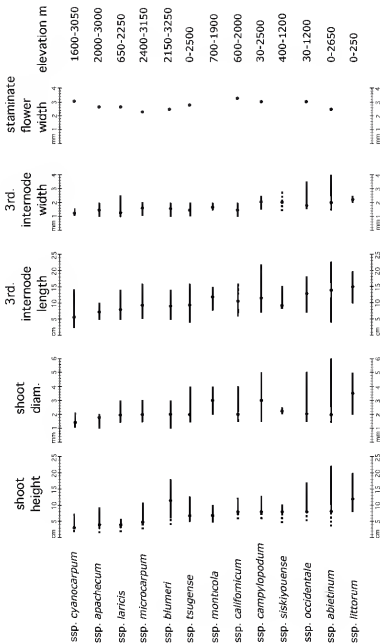


Fig. 1. Values for five morphological characters used in Hawksworth and Wiens (1996) for the 13 subspecies of *Arceuthobium campylopodum*. The solid lines represent the ranges of values reported and the dot the mean. Dashed lines indicate that no minimum (or for *ssp. siskiyouense* third internode width minimum or maximum) values were reported. Staminate flower widths were not reported for *ssp. litonum*, *ssp. monticola*, and *ssp. siskiyouense*. Also shown are the altitudinal ranges for each taxon.

the same chromosome number ( $n = 14$ ) and similar chromosome morphology. Moreover, given the overlap in the ranges of morphological characters among members of sect. *Campylopoda*, it would be difficult to identify a hybrid individual based on intermediate morphology. Many nonparasitic angiosperm species have been tested for reproductive isolation by conducting artificial cross-pollinations, either under field, common garden, or laboratory conditions. Such crossing experiments usually document a range of outcomes for the next generations, from complete genetic barriers (no successful crosses) to partially fertile or fully fertile  $F_1$  or  $F_2$  progeny. Unfortunately, very few interspecific cross-pollination experiments have been conducted with *Arceuthobium*. Mathiasen (1982) crossed staminate *A. blumeri* with carpellate *A. apachecum* and obtained no fruits; however, the control pollinations also had low fruit set. No study involving cross-pollination of all taxa of *Arceuthobium* sect. *Campylopoda* has been published, thus compatibility data are generally lacking.

**Geographical isolation and sympatry.** The degree of sympatry present among species of dwarf mistletoe was discussed in Hawksworth and Wiens (1996), with proximity categories set at within 30 m, 400 m, and 2 km. Comparing subspecies of sect. *Campylopoda* (Table 1) using these criteria, all but two are sympatric with at least one other member of the section (the exceptions being *A. campylopodum* subsp. *blumeri* and subsp. *littorum*). *Arceuthobium* pollen is dispersed by both insects and wind, and the latter may account for long-range pollen dispersal. For example, Leopold (1967) found dwarf mistletoe pollen in traps where the nearest population was 16 km away. Given that distance, the number of sympatric species in sect. *Campylopoda* would increase. The two taxa with the highest number of sympatric species are *A. campylopodum* subsp. *abietinum* and subsp. *campylopodum*, with eight and seven species, respectively. For *A. campylopodum* subsp. *campylopodum* and subsp. *occidentale*, a number of populations exist where both principal hosts (*P. ponderosa* and *P. sabiniana*, respectively) are being parasitized, and here the mistletoes are morphologically and genetically indistinguishable (Nickrent 1987).

Table 1. Degree of sympatry among subspecies of *Arceuthobium campylopodum*.<sup>1</sup>

Taxon (abbreviation)	30, 400 m	2 km	# 30, 400 m	# 2 km	Total
subsp. <i>abietinum</i> (ABI)	CAL, CAM, CYA, OCC, TSU	LAR, MIC, TSU	5	3	8
subsp. <i>apachecum</i> (APA)	MIC		1	0	1
subsp. <i>blumeri</i> (BLU)			0	0	0
subsp. <i>californicum</i> (CAL)	ABI	CAM	1	1	2
subsp. <i>campylopodum</i> (CAM)	ABI, CYA, LAR, MON, OCC, SIS	CAL	6	1	7
subsp. <i>cyanocarpum</i> (CYA)	ABI, CAM		2	0	2
subsp. <i>laricis</i> (LAR)	CAM	ABI	1	1	2
subsp. <i>littorum</i> (LIT)			0	0	0
subsp. <i>microcarpum</i> (MIC)	APA	ABI	1	1	2
subsp. <i>monticola</i> (MON)	CAM, SIS		2	0	2
subsp. <i>occidentale</i> (OCC)	ABI, CAM		2	0	2
subsp. <i>siskiyouense</i> (SIS)	CAM, MON		2	0	2
subsp. <i>tsugense</i> (TSU)	ABI		1	0	1

<sup>1</sup> Data derived from Hawksworth and Wiens (1996)

Table 2. Hosts of the subspecies of *Arceuthobium campylopodum*<sup>1</sup>

Host	subsp. <i>abietinum</i>	subsp. <i>apachecum</i>	subsp. <i>blumeri</i>	subsp. <i>californicum</i>	subsp. <i>campylopodum</i>	subsp. <i>cyanocarpum</i>
<i>Abies amabilis</i>	0.33 <sup>2</sup>					
<i>Abies concolor</i>	1					
<i>Abies durangensis</i>	1					
<i>Abies grandis</i>	1					
<i>Abies lasiocarpa</i>	0.5					
<i>Abies magnifica</i>	1					
<i>Abies procera</i>						
<i>Larix occidentalis</i>						
<i>Picea breweriana</i>	0.5					
<i>Picea engelmannii</i>						0.25
<i>Picea pungens</i>						
<i>Picea sitchensis</i>						
<i>Pinus albicaulis</i>						1
<i>Pinus aristata</i>						1
<i>Pinus ayacahuite</i>	0.33		1			
<i>Pinus attenuata</i>					0.5	
<i>Pinus balfouriana</i>						0.33
<i>Pinus contorta</i>	0.33				0.33	0.25
<i>Pinus coulteri</i>					0.5	
<i>Pinus flexilis</i>						1
<i>Pinus jeffreyi</i>					1	
<i>Pinus lambertiana</i>	0.33			1	0.25	
<i>Pinus longaeva</i>						1
<i>Pinus monticola</i>	0.33			0.5		0.5
<i>Pinus muricata</i>						
<i>Pinus ponderosa</i>					1	0.25
<i>Pinus radiata</i>						
<i>Pinus sabina</i>					0.33	
<i>Pinus strobiformis</i>		1	1			
<i>Pseudotsuga menziesii</i>						
<i>Tsuga heterophylla</i>						
<i>Tsuga mertensiana</i>						0.5
<b>Inverse specificity</b>	6.65	1	2	1.5	3.91	6.08
<b>Number of principal hosts</b>	4	1	2	1	2	4

Table 2, cont.

Host	subsp. <i>laricis</i>	subsp. <i>littoratum</i>	subsp. <i>microcarpum</i>	subsp. <i>monticola</i>	subsp. <i>occidentale</i>	subsp. <i>siskiyouense</i>	subsp. <i>tsugense</i>
<i>Abies amabilis</i>							1
<i>Abies concolor</i>							
<i>Abies durangensis</i>							
<i>Abies grandis</i>	0.25						0.33
<i>Abies lasiocarpa</i>	0.33		0.25				1
<i>Abies magnifica</i>							
<i>Abies procera</i>							1
<i>Larix occidentalis</i>	1						
<i>Picea breweriana</i>				0.33			0.25
<i>Picea engelmannii</i>	0.25		1				0.25
<i>Picea pungens</i>			1				
<i>Picea sitchensis</i>							0.25
<i>Pinus albicaulis</i>	0.25						0.5
<i>Pinus aristata</i>			1				
<i>Pinus ayacahuite</i>							
<i>Pinus attenuata</i>					0.5	1	
<i>Pinus balfouriana</i>							
<i>Pinus contorta</i>	0.5	0.33				0.25	1
<i>Pinus coulteri</i>					0.5		
<i>Pinus flexilis</i>							
<i>Pinus jeffreyi</i>				0.25	0.33	0.25	
<i>Pinus lambertiana</i>				0.5			
<i>Pinus longaeva</i>							
<i>Pinus monticola</i>	0.25			1			0.33
<i>Pinus muricata</i>		1					
<i>Pinus ponderosa</i>	0.33				0.33	0.25	
<i>Pinus radiata</i>		1			* <sup>3</sup>		
<i>Pinus sabiana</i>					1		
<i>Pinus strobiformis</i>			0.25				
<i>Pseudotsuga menziesii</i>							0.25
<i>Tsuga heterophylla</i>							1
<i>Tsuga mertensiana</i>	1						1
<b>Inverse specificity</b>	4.16	2.33	3.5	2.08	2.66	1.75	8.16
<b>Number of principal hosts</b>	1	2	3	1	1	1	6

<sup>1</sup> Data derived from Hawksworth and Wiens (1996). <sup>2</sup> 1 = principal host, 0.5 = secondary, 0.33 = occasional, 0.25 = rare

<sup>3</sup> *A. campylopodum* subsp. *occidentale* parasitizes cultivated *Pinus radiata*.

**Host relationships.** Looking at specificity from the host perspective, nearly all Pinaceae species are principal host for just one *Arceuthobium* taxon (Table 2). Exceptions include *Pinus strobiformis* and *Tsuga mertensiana*, which serve as principal hosts for two dwarf mistletoe taxa. When viewed from the parasite perspective, 7 of the 13 subspecies of sect. *Campylopoda* have more than one principal host (Table 2). Some taxa, such as *A. campylopodum* subsp. *abietinum*, subsp. *cyanocarpum*, and subsp. *tsugense* have four or more principal hosts and broad host ranges overall. The latter is recorded from five different genera of conifers: *Abies*, *Picea*, *Pinus*, *Pseudotsuga*, and *Tsuga*. Although occasional or rare occurrences could be dismissed as insignificant when viewing the preponderance of mistletoes found on principal hosts, these occurrences likely provide some evidence that these species at least have the genetic propensity for being generalists. A measure of generality (“inverse specificity”) is shown in Table 2, calculated as the sum of successively down-weighted secondary, occasional, and rare hosts. Although phylogenetic data do not yet allow inference on this matter, the ancestor to all species of sect. *Campylopoda* could have been a generalist (the plesiomorphic state). From that ancestor, capable of parasitizing a number of host species, populations evolved with greater specialization along host lines.

**Genetic divergence.** Given the absence of empirical cross-pollination data testing interspecific compatibility in *Arceuthobium*, the next best approach is to directly measure genetic divergence among the species. The first tests of interspecific genetic differences between species of sect. *Campylopoda* utilized isozymes, where all members of the section had greater than 80% Nei’s unbiased genetic identity values (Nickrent et al. 1984; Nickrent 1986). Moreover, these isozyme analyses did not result in clusters corresponding to species in sect. *Campylopoda* as defined by Hawksworth and Wiens (1972) or with similarity values consistent with other members of the genus. A more detailed isozyme analysis conducted using 500 individuals of *A. campylopodum* and *A. occidentale* showed no consistent difference between these two taxa (Nickrent 1987).

As stated above, both ITS and *trnT-L* region DNA sequences showed identity to near identity among all species of sect. *Campylopoda*. Moreover, all these species share a unique 156 bp deletion in the *trnT-L* spacer. Both of these spacers have been used with many other angiosperms in studies of species relationships. Although ITS may not be ideal for some taxonomic groups or biological situations (Alvarez & Wendel 2003), it continues to be a useful phylogenetic marker for a vast array of plants and it cannot be discounted as being too problematic. Along with chloroplast *rbcL* and *matK*, it can be used as a barcode sequence for seed plants (China Plant BOL Group 2011) and indeed among the markers tested showed the greatest ability to discriminate species (67.2%).

### The concept of ecotype and *Arceuthobium* sect. *Campylopoda*

As used by ecological geneticists, ecotypes represents populations that have fixed genotypic adaptations to particular ecological niches. The work on ecotypes by Clausen et al. (1940) has been supported and extended into the modern genomic era by work on model plants such as *Arabidopsis* (Park et al. 2009). That study compared protein patterns among three *Arabidopsis* ecotypes and showed that their genetic diversity was reflected in quantitative differences in the protein expression patterns. A more explicit enumeration of terms describing microevolutionary units took place with the development of the “deme” concept (Briggs & Block 1981). For both ecotypes and demes, the names assigned to these units were not intended to be ranks within formal botanical nomenclature. That said, infraspecific variation in plants is frequently documented using the ranks “variety” and “subspecies.” For example, the classic study of ecotypes in *Potentilla glandulosa* (Clausen et al. 1940) involved four subspecies: *glandulosa* (*typica*), *reflexa*, *hanseni*, and *nevadensis*.

In the case of *Arceuthobium*, the most important environmental component is the host tree. As with *Potentilla glandulosa*, native to Stanford but succumbing when grown at Timberline, seeds of *Arceuthobium campylopodum* derived from parasites on one particular host species may not



survive as seedlings on a host tree of another species. It seems that taxa within the *A. campylopodium* complex conform to the concept of ecotype. In addition to the host, whose distribution is correlated with elevation, such a correlation may also exist in *Arceuthobium*. The 13 taxa of sect. *Campylopoda* were arranged according to shoot height (Fig. 1), and it appears that the tallest shoots are at lower elevations and the smaller shoots at higher elevations. It is also likely that flowering and fruiting times have a strong elevational component. The exception seems to be *A. blumeri*, which is the most dissimilar genetically within the entire section.

### Subspecific ranks for *Arceuthobium campylopodium*

In plants, the ranks of variety and subspecies have approximately equal, albeit somewhat regional, usage (variety favored in the USA, subspecies elsewhere). Attempts to arrive at a consensus as to what conditions can be used to precisely define these two ranks have mostly failed (Hamilton & Reichard 1992). It is often assumed that subspecies is more associated with biogeographically separate population clusters, but this usage appears more consistent among animal as opposed to plant taxonomists. As stated by Raven (1974) "it is clearly not possible to assume from the fact the category 'subspecies' or 'variety' has been applied within a given species that a certain pattern of variation is present; only, in either case, that the species has been subdivided."

The phylogenetic classification of *Arceuthobium campylopodium* (Nickrent et al. 2004) did not specify subspecific ranks within this species. Given that these 13 taxa have been recognized as species in previous classifications and the importance of these mistletoes in North American forestry, these infraspecific taxa within sect. *Campylopoda* will be formally recognized here at the rank of subspecies. This rank is already being used for *A. vaginatum* subsp. *vaginatum* and *A. vaginatum* subsp. *cryptopodium*. The former is widespread in Mexico whereas the latter is most common in the western USA. The two subspecies are parapatric, coming into contact in Sinaloa, Mexico. The rank of subspecies has also been used in *A. tsugense*. Thus, to retain consistency within the genus, subspecies will be used instead of the rank of variety.

In terms of geographic distributions, the 13 subspecies of *A. campylopodium* show varying associations with each other, these ranging from complete allopatry to parapatry and finally sympatry. If one translates the data shown in Table 1 to a 13 X 13 matrix, 78 cells result as possible cases of sympatry. Of these, 15 cells are occupied, thus less than 20% of the time are cases reported for sympatry among these subspecies. The two taxa that show the highest levels of sympatry are *A. campylopodium* subsp. *abietinum* and *A. campylopodium* subsp. *campylopodium*. Looking at the overall distributions, one could suggest four general categories based on geography that could be used to define four subspecies: California (subspecies *californicum*, *campylopodium*, *littorum*, *monticola*, *occidentale*, and *siskiyouense*), Northwest (subspecies *laricis* and *tsugense*), Southwest (subspecies *apachecum*, *blumeri*, and *microcarpum*) and Western USA (*abietinum* and *cyanocarpum*). This approach will not be recommended here because (1) there is no phylogenetic evidence that the subspecies placed in these categories are more similar to one another than to other subspecies of *A. campylopodium*, (2) the members of these categories do not appear to have any morphologically coherent features, and (3) these categories do not have any correlation with ecological conditions or host species. For these reasons, and to retain some connection to the species names currently being used by various applied fields (such as forestry, which follows the Hawsworth and Wiens system), 13 subspecific names will be used.

### Nomenclature

For the taxa in sect. *Campylopoda*, a number of species of Hawsworth and Wiens (1972, 1996) had previously been recognized as varieties of *A. campylopodium*. These are here being recognized at the rank of subspecies (stat. nov.).

*ARCEUTHOBIUM CAMPYLOPODUM* Engelm. in A. Gray, Boston J. Nat. Hist. 6: 214. 1850.

1. *Arceuthobium campylopodum* subsp. *campylopodum*.

*Arceuthobium campylopodum* Engelm. forma *typicum* L.S. Gill, Trans. Connecticut Acad. Arts 32: 185. 1935.

*Arceuthobium campylopodum* Engelm. var. *brachyarthon* Engelm. in A. Gray, Boston J. Nat. Hist. (Pl. Lindheim. pt. 2) 6: 214. 1850.

*Arceuthobium campylopodum* Engelm. var. *macrarthon* Engelm. in A. Gray, Boston J. Nat. Hist. (Pl. Lindheim. pt. 2) 6: 214. 1850.

*Razoumofskyia campylopoda* (Engelm.) Kuntze, Revis. Gen. Pl. 2: 587. 1891.

2. *Arceuthobium campylopodum* subsp. *abietinum* (Engelm.) Nickrent, comb. & stat. nov.  
*Arceuthobium douglasii* Engelm. var. *abietinum* Engelm. in S. Wats., Bot. California 2: 106. 1880.

*Arceuthobium abietinum* (Engelm.) Hawks. & Wiens, Brittonia 22: 68. 1970.

*Arceuthobium abietinum* (Engelm.) Hawks. & Wiens forma *speciales concoloris* Hawks. & Wiens, Brittonia 22: 267. 1970.

*Arceuthobium abietinum* (Engelm.) Hawks. & Wiens forma *speciales magnificae* Hawks. & Wiens, Brittonia 22: 268. 1970.

*Arceuthobium campylopodum* Engelm. forma *abietinum* L.S. Gill, Trans. Connecticut Acad. Arts 32: 195. 1935.

*Razoumofskyia abietina* (Engelm.) Abrams, Ill. Fl. Pacific States 1: 530. 1923.

*Razoumofskyia abietina* (Engelm.) Abrams forma *parvula* Tubeuf [nomen nudum], Naturwiss. Z. Forst Landw. 17: 219. 1919. .

*Razoumofskyia abietina* (Engelm.) Abrams forma *magna* Tubeuf [nomen nudum], Naturwiss. Z. Forst Landw. 17: 220. 1919.

*Razoumofskyia douglasii* (Engelm.) Kuntze var. *abietina* (Engelm.) Greene, Fl. Francisc. 3: 341. 1892.

*Arceuthobium occidentale* Engelm. var. *abietinum* Engelm. in S. Watson, Bot. California 2: 107. 1880.

3. *Arceuthobium campylopodum* subsp. *blumeri* (A. Nelson) Nickrent, comb. & stat. nov.  
*Arceuthobium blumeri* A. Nelson, Bot. Gaz. 56: 65. 1913.

*Arceuthobium campylopodum* Engelm. forma *blumeri* (Engelm.) L.S. Gill, Trans. Connecticut Acad. Arts 32: 207. 1935.

*Razoumofskyia blumeri* (A. Nelson) Standley, Proc. Biol. Soc. Washington 29: 86. 1916.

The argument could be made that this taxon should be recognized as a distinct species (*A. blumeri*) because it differs genetically from others in sect. *Campylopoda* and is completely allopatric from all of them. But given its high morphological similarity to other members of the section, it is here considered one of the 13 subspecies of *A. campylopodum*.

4. *Arceuthobium campylopodum* subsp. *cyanocarpum* (A. Nelson ex Rydb.) Nickrent, comb. & stat. nov. *Razoumofskyia cyanocarpa* A. Nelson ex Rydb., Fl. Colorado 100, 101. 1906.

*Arceuthobium campylopodum* Engelm. forma *cyanocarpum* L.S. Gill, Trans. Connecticut Acad. Arts 32: 204. 1935.

*Arceuthobium cyanocarpum* (A. Nelson ex Rydb.) J.M. Coult. & A. Nelson, New Man. Bot. Centr. Rocky Mts. 146. 1909.

5. *Arceuthobium campylopodum* subsp. *laricis* (M.E. Jones) Nickrent, comb. & stat. nov.  
*Arceuthobium douglasii* Engelm. var. *laricis* M.E. Jones, Bull. Montana Univ., Biol. Ser. 15: 25. 1910.

- Arceuthobium laricis* (Piper) H. St. John, Fl. Southeastern Washington 115. 1936.  
*Arceuthobium campylopodum* Engelm. forma *laricis* (Piper) L.S. Gill, Trans. Connecticut Acad. Arts. 32: 202. 1935.  
*Razoumofskyia douglasii* (Engelm.) Kuntze subsp. *laricis* Piper [nomen nudum], Contr. U.S. Natl. Herb. 11: 223. 1906.  
*Razoumofskyia laricis* Piper in Piper and Beattie, Fl. Southeast. Washington 80. 1914.
6. *Arceuthobium campylopodum* subsp. *microcarpum* (Engelm.) Nickrent, comb. & stat. nov.  
*Arceuthobium douglasii* Engelm. "var.?" *microcarpum* Engelm. in Rothrock, Rep. U.S. Geogr. Surv., Wheeler 6: 253. 1878.  
*Arceuthobium microcarpum* (Engelm.) Hawksw. & Wiens, Brittonia 22: 268. 1970.  
*Arceuthobium campylopodum* Engelm. forma *microcarpum* (Engelm.) L.S. Gill, Trans. Connecticut Acad. Arts 32: 209. 1935.  
*Razoumofskyia douglasii* (Engelm.) Kuntze var. *microcarpa* (Engelm.) Tubeuf [nomen nudum?], Naturwiss. Z. Forst Landw. 17: 216. 1919.  
*Razoumofskyia microcarpa* (Engelm.) Wooton & Standley, Contr. U.S. Natl. Herb. 19: 179. 1915.
7. *Arceuthobium campylopodum* subsp. *tsugense* (Rosend.) Nickrent, comb. & stat. nov.  
*Razoumofskyia tsugensis* Rosend., Minnesota Bot. Stud. 3: 272, pl. 27, 28. 1903.  
*Arceuthobium tsugense* (Rosend.) G.N. Jones subsp. *amabilae* Mathiasen & C.M. Daugherty, Novon 17: 223. 2007.  
*Arceuthobium tsugense* (Rosend.) G.N. Jones subsp. *contortae* Wass & Mathiasen, Novon 13: 269. 2003.  
*Arceuthobium tsugense* (Rosend.) G.N. Jones subsp. *mertensianae* Hawksw. & Nickrent, Novon 2: 209. 1992.  
*Arceuthobium tsugense* (Rosend.) G.N. Jones, Univ. Wash. Publ. Biol. 5: 139. 1936.  
*Arceuthobium campylopodum* forma *tsugensis* L.S. Gill, Trans. Connecticut Acad. Arts 32: 200. 1935.
8. *Arceuthobium campylopodum* subsp. *apachecum* (Hawksw. & Wiens) Nickrent, comb. & stat. nov. *Arceuthobium apachecum* Hawksw. & Wiens, Brittonia 22: 266. 1970.
9. *Arceuthobium campylopodum* subsp. *californicum* (Hawksw. & Wiens) Nickrent, comb. & stat. nov. *Arceuthobium californicum* Hawksw. & Wiens, Brittonia 22: 266. 1970.  
*Arceuthobium campylopodum* Engelm. var. *cryptopodum* (Engelm.) Jepson, Man. Fl. Pl. Calif. 284. 1925.
10. *Arceuthobium campylopodum* subsp. *littorum* (Hawksw, Wiens & Nickrent) Nickrent, comb. & stat. nov. *Arceuthobium littorum* Hawksw., Wiens & Nickrent, Novon 2: 206. 1992.
11. *Arceuthobium campylopodum* subsp. *monticola* (Hawksw., Wiens & Nickrent) Nickrent, comb. & stat. nov. *Arceuthobium monticola* Hawksw., Wiens & Nickrent, Novon 2: 205. 1992.
12. *Arceuthobium campylopodum* subsp. *occidentale* (Engelm.) Nickrent, comb. & stat. nov. *Arceuthobium occidentale* Engelm., U.S. Geographical Survey West of 100th Meridian (Wheeler Report) 6: 375. 1878.  
*Razoumofskyia occidentale* (Engelm.) Kuntze, Revis. Gen. Pl. 2: 587. 1891.
13. *Arceuthobium campylopodum* subsp. *siskiyouense* (Hawksw., Wiens & Nickrent) Nickrent, comb. & stat. nov. *Arceuthobium siskiyouense* Hawksw., Wiens & Nickrent, Novon 2: 204. 1992.

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**GAMOCHAETA ARGYRINEA (ASTERACEAE)  
NATURALIZED IN CALIFORNIA**

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**ABSTRACT**

*Gamochoeta argyrinea* is naturalized in the Lake Oroville area of Butte Co., California, first documented there in 1990 and again in 2000, its persistent presence confirmed in 2012. It probably arrived there from a locality in the southeastern USA.

Curation of UC and JEPS Asteraceae collections has brought attention to a previously unreported non-native species naturalized in the California flora.

**GAMOCHAETA ARGYRINEA** G.L. Nesom, Sida. 21: 718, figs. 1-4. 2004.

**California.** Butte Co.: ca. 1/8 mi NW of the Enterprise Bridge across Lake Oroville, E of the Enterprise Boat Launch Area, growing on fine damp bare disturbed granite soil, below the high water line of Lake Oroville, Foothill Woodland (destroyed), 850 ft, normal size plants, uncommon, scattered, 25 May 1990, *Lowell Ahart 6481* (UC, Figure 1); ca. 1/2 mi SW of the Enterprise Bridge across Lake Oroville, below the high water line of Lake Oroville, Foothill Woodland (destroyed), 850 ft, growing on dry bare white disturbed granite soil, large size plants, few plants seen, 16 Jun 1990, *Lowell Ahart 6523* (UC); ca. 5 mi (air) SW of Oroville, W of Larkin Road, ca. 1 1/4 mi S of the Oroville Airport, on the margin of the Thermalito Afterbay, on the W side of the access road to the boat ramp at the Thermalito Afterbay, damp red disturbed gravelly soil, freshwater marsh, 140 ft, common, normal size plants, 13 May 2000, *Lowell Ahart 8345* (JEPS; Figure 2).

Species collected by Ahart on the same day at each of the three Lake Oroville localities are characteristic of disturbed habitats and nearly half of them are not native to California. In 1990, with *Ahart 6481*: *Agrostis avenacea*, *Chorizanthe membranacea*, *Filago californica*, *Juncus acuminatus*, *Juncus biflorus*, *Juncus tenuis*, *Lindernia dubia*, *Leontodon saxatilis*, *Polygonum hydropiper*, *Polypogon interruptus*, *Rumex acetosella*, *Silene antirrhina*, *Torilis arvensis*, and *Vicia americana*. In 1990, with *Ahart 6523*: *Agoseris heterophylla*, *Alopecurus carolinianus*, *Apocynum cannabinum*, *Centaureum muhlenbergii*, *Centaureum tenuiflorum*, *Digitaria sanguinalis*, *Eragrostis cilianensis*, *Eriodictyon californicum*, *Pseudonaphalum stramineum*, *Herniaria hirsuta*, *Kickxia elatine*, *Lonicera interrupta*, *Polygonum hydropiper*, *Rorippa palustris*, *Scleranthus annuus*, *Uropappus lindleyi*, and *Veronica peregrina* subsp. *xalapensis*. In 2000, with *Ahart 8345*: *Castilleja attenuata*,

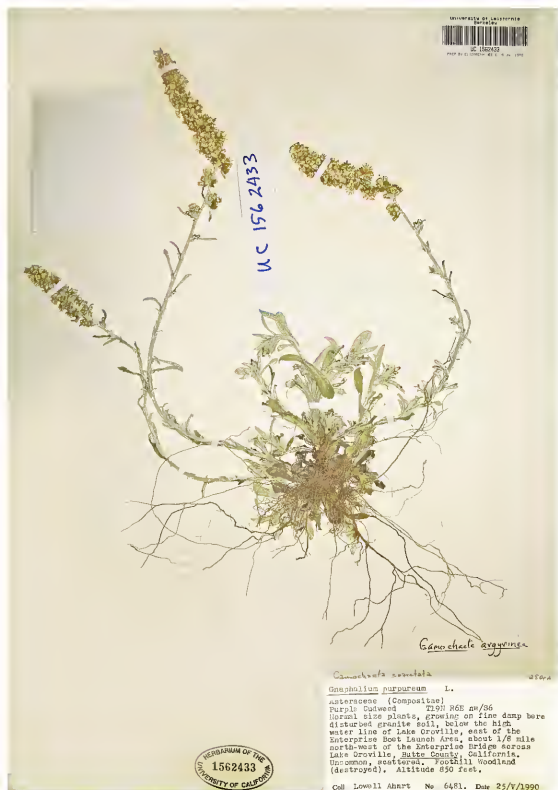


Figure 1 *Gamochaeta argyrynea* from Butte County (UC), northwest of the Enterprise Bridge, 25 May 1990



Figure 2. *Gamochaeta argyræa* from Butte County (JEPS), margin of the Thermalito Afterbay, 13 May 2000

*Centunculus minimus*, *Crucianella angustifolia*, *Eleocharis macrostachya*, *Galium tricornutum*, *Gastroidium phleoides*, *Gastroidium ventricosum*, *Juncus acuminatus*, *Lathyrus angulatus*, *Plagiobothrys stipitatus*, *Plantago coronopus*, *Plantago virginica*, *Pseudognaphalium stramineum*, *Ranunculus pusillus*, *Rorippa curvisiliqua*, *Trifolium cernuum*, *Trifolium dubium*, and *Triodanis biflora*. Records for these collections are from the Consortium of California Herbaria (2012)



Figure 3 *Gamochaeta argyrinea* at Thermalito Afterbay site, 17 May 2012

On 17 May 2012, Strother and Moe found the *Ahart* 6481 site to be under water and collected *Gamochaeta argyrinea* at the *Ahart* 8345 site (Figure 3, Thermalito Afterbay, *Strother* 1373, UC, duplicates to MO and TEX). They scanned and searched roadsides along minor roads but saw no other *gamochaetas*.

The Enterprise Bridge localities are about 20 miles from the Thermalito Afterbay — boat ramps are at both places. Perhaps cypselae in mud on tires and/or trailers account for the transport from one boat ramp area to another as well as the original dispersal to California. The popularity of Lake Oroville for bass fishing makes this a plausible scenario.

*Gamochaeta argyrinea* has previously been known only from the southeastern USA (the type from North Carolina, Nesom 2004, 2006, 2007), where it reaches eastern Texas and Oklahoma at the westernmost extension of its range. It is essentially restricted to disturbed habitats and appears to have become widespread in the USA only recently.



The species most similar to *Gamochaeta argyrinea* appears to be *G. ustulata* (Nutt.) Holub, which is native to the Pacific Coast of the USA and southern British Columbia. Most of the other close relatives of *G. argyrinea* are from South America and it is perhaps native there, even though its occurrence has not been reported (Freire & Iharlegui 1997). In any case, it is likely that the Butte County plants are adventive from a locality in the southeastern USA.

#### ACKNOWLEDGEMENTS

We and the botanical community are indebted to Lowell Ahart and other collectors who have contributed (and continue to contribute) over the years and decades to documentation of plant distributions and introductions in California and beyond.

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**PHYSARIA IVEYANA (BRASSICACEAE), A NEW SPECIES FROM THE  
SANDIA MOUNTAINS, NEW MEXICO**

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**ABSTRACT**

*Physaria iveyana* (Brassicaceae), a new species from the summit of the Sandia Crest, Sandia Mountains, New Mexico, is described and illustrated. This entity has long been known as distinctive and has been recognized as deviating from typical *P. pinetorum* in that it has subumbellate infructescences that do not elongate and that do not or only barely exceed the basal leaves, forms dense rock-hugging tufts, and occurs at a higher elevation and in a more extreme wind-swept habitat.

**KEY WORDS:** *Physaria iveyana*, *Physaria pinetorum*, Brassicaceae, Sandia Mountains

In their treatment of the genus *Lesquerella* S. Watson — now mainly included in *Physaria* (Nuttall) A. Gray — Rollins and Shaw (1993) noted that at high elevations in the Sandia Mountains of New Mexico some populations of *Physaria pinetorum* (Wootton & Standley) O'Kane & Al-Shehbaz are strongly reduced. They stated (p. 132) that these plants “. . . are small and matted and tend to have spatulate to oblanceolate basal leaves, often less than 2 cm. long, with a short slender petiole. The stems are greatly reduced, frequently not extending beyond the leaves, and the infructescences are subcorymbose.” Rollins and Shaw concluded that this unusual form was simply a morphological response to edaphic conditions and high elevation. To the best of our knowledge, no similar plants are found in harsh, high-elevation habitats elsewhere. Where *P. pinetorum* is elsewhere found growing in these conditions, the plants are smaller but are otherwise typical for the species. Julian and Stuever (2005) indicated that other species of *Physaria* in the Sandia Mountains typically grow in the dry foothills but that *P. pinetorum*, while growing there, also grows on the crest of the mountains.

In his early monograph of *Lesquerella*, Payson (1921) implied that there was considerable variation among the few specimens of *Physaria pinetorum* at his disposal and wondered if two or more varieties should be recognized (p. 194). One of the specimens he examined, *Herrick 204* (US), came from the crest of the Sandias. An annotation on this specimen indicates that Wootton and Standley considered naming this form “*Lesquerella parva*,” although they did not publish the name (Rollins & Shaw 1973). O'Kane (2010) previously opined that the dwarfed, high-elevation specimens from the crest of the Sandias should be recognized as a separate taxon. We here describe this new taxon at specific rank.

**PHYSARIA IVEYANA** O'Kane, K.N. Smith, and K.A. Arp, sp. nov. TYPE: USA. New Mexico. Bernalillo Co.: Sandia Mountains, The Sandia Crest, 35° 12.609' N, 106° 26.981' W, 10,700 ft (3723 m) elev. 9 Jul 2009, S.L. O'Kane, Jr. 9197 (holotype, MO; isotypes, ARIZ, BRY, COLO, GH, ISTC, K, NMC, NY, UNM).

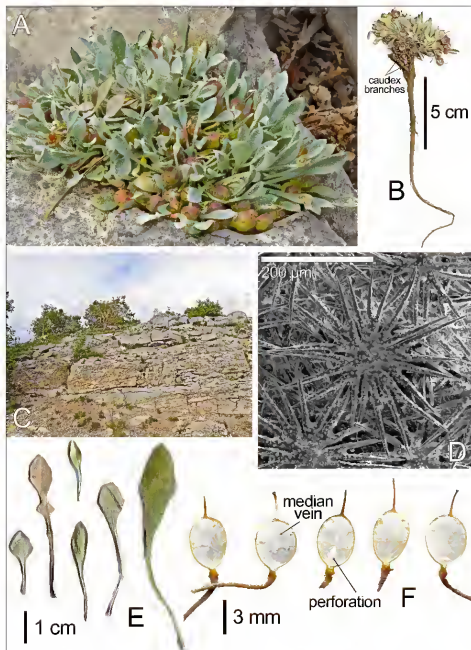


Figure 1. A. Habit B. Above and below-ground phenotype. C. Limestone habitat. D. SEM micrograph of trichome detail. E. Basal leaf variation. F. Replum and septum variation.

*Physaria ivelyana* differs from *P. pinetorum* in that it has subumbellate infructescences (rather than obviously racemose) that do not elongate (rather than elongate) and that do not or only barely exceed (rather than exceed) the basal leaves, forms dense rock-hugging tufts (rather than forming looser tufts), and occurs at a higher elevation and in a more extreme wind-swept habitat (rather than occurring generally below 2900 m elevation in more protected spots).

**Herbs**, long-lived perennials from a taproot, forming small densely caespitose ground-hugging tufts from a simple or usually sparsely and closely branched underground caudex, caudex branches 2–8 mm long  $\times$  0.5–4.3 mm wide, elongating slightly with age, old leaf bases mostly deciduous. **Stems** 2–10(–18) per plant, (0.2–)0.5–5.5(–6.5) cm long, unbranched, ascending to erect, arising from within the 3.5–12.0 cm wide tuft of erect or ascending basal leaves. **Herbage** pale-green to gray-green, densely covered with overlapping stellate trichomes, the herbage silvery gray-green, sometimes tinged purple, the silver color due to a dense, covering of overlapping stellate trichomes, these 250–375  $\mu$ m in diameter from tip to tip, with 7–9 main rays, each bifurcating, and sometimes bifurcating again, sometimes incompletely, ray tips (14–)17–23 per trichome, main rays webbed at the very base (visible at high magnification), trichome center slightly-mounded and tuberculate. **Leaves**: basal mainly entire, larger leaves often undulate, or lyrate, or with 2–few weak teeth, blades mainly spatulate, some rhombic or elliptic, flat, tapering to a slightly winged petiole, apex curved-obtuse to slightly rounded-acute, including the petiole 12–50(–64) mm  $\times$  1–8(–11) mm, encrusted with trichomes; cauline entire, narrowly spatulate to nearly elliptic, flat, attenuate at base and tapering to a slightly winged petiole, (0–)2–6 per stem, including the petiole 5–26(–31) mm  $\times$  1–5 mm. **Infructescence** not elongating, not exceeding or barely exceeding the basal leaves, a condensed nearly umbellate raceme with 3–16,  $\pm$  crowded fruits, on ultimately sigmoid (some ascending) pedicels 4.5–15(–20) mm long. **Flowers** with sepals 4.3–5 mm long, elliptic to narrowly triangular, rounded on back, lateral sepals often keeled at the base; petals entire, yellow, 5.5–8.1 mm long, blade 2.2–3.6 mm wide, claw 0.7–1.3 mm wide, spatulate or the blade somewhat wider. **Stamens** 6, the median ones with filaments 3.4–4.1 mm long, lateral ones 2.3–3.8 mm long; anthers 0.9–1.1 mm long, oblong to narrowly triangular in outline, basal lobes usually flaring, these 0.2–0.5 mm long. **Silicles** on stipes 0.2–0.7 mm, ovoid to nearly spherical, apex rounded; base rounded-obtuse; mostly longer than wide, 3.4–6.2  $\times$  2.0–4.6 mm; valves glabrous within and on the exterior, becoming purple-coppery at maturity. **Ovules** (10–)12–16(–20) per ovary, these attached to the upper 1/2–2/3 of the replum; false septum mostly entire to less frequently perforate basally in the center; replum obovate to subovate, rounded at the apex. **Styles** fine, glabrous, linear to curved apically, (1–)2.5–4.0 mm, including the capitate stigma, which is slightly wider than the style. **Seeds**, flattened, lenticular, brown to dark brown, oval to suborbicular, wider than long, 1.4–2.0  $\times$  1.3–1.9 mm, wingless, slightly mucilaginous when wetted; cotyledons accumbent. Figure 1.

**Paratype**. USA. New Mexico. Bernalillo Co.: Sandia Crest, Sandia Mountains. 35°12.641' N, 106°26.983' W, 10,690 ft (3258 m) elev, 23 July 2008, S.L. O'Kane, Jr. & K.D. Heil 9056 (ISTC, SJNM).

**Etymology**. The species is named for Robert DeWitt Ivey, outstanding New Mexico naturalist. Raised in Jacksonville, Florida, he graduated from the University of Florida in 1945 as class valedictorian with a double major in English and biology. He continued his studies there specializing in mammalogy under Dr. Harley Sherman. In 1947 he became an instructor at the University of New Mexico. In 1949 he did more graduate work at the University of Michigan and then spent a year teaching at the College of Charleston in South Carolina. In 1951 he felt the need to return to the wide-open skies of New Mexico and started teaching biology for the Albuquerque Public Schools. He and his students continued his work on mammals until the threat of bubonic plague and Hantavirus became a problem. He then turned his attention to botany and in 1983 published the first edition of his manual of botanical illustrations, *Flowering Plants of New Mexico*, which had hundreds

of drawing of species which cleverly focused in on the most important characters for identification. In 2008 the greatly expanded fifth edition was published, illustrating more than one third of the species known for the state. *Flowering Plants of New Mexico* is likely the most consulted plant identification reference in the state and is used as a text in the Flora of New Mexico course at the University of New Mexico. Ivey has given numerous talks, workshops, and field trips throughout the state. His work has done much, perhaps more than any other, to stimulate interest in the plants of New Mexico and their appreciation and preservation.



Figure 2. Locality of type collection and additional local area searched. Image from Google Earth

**Ecology.** *Physaria iveyana* (Ivey's bladderpod) inhabits the wind-swept, relatively high-elevation, barren grey Madera Formation limestone escarpment on the west-facing summit of Sandia Peak (Read et al 2000) (Fig 2). It grows from fractures in the exposed limestone or in nearly barren limestone rubble with nearby individuals of the trees *Pinus strobiformis*, *Pseudotsuga menziesii*, and stunted individuals of *Populus tremuloides*. Scattered herbaceous plants include species of *Allium*,

*Pedicularis*, *Poa*, *Erigeron*, *Achillea*, *Cerastium*, *Cymopterus*, *Hymenoxys*, *Penstemon*, and *Oxytropis*.

*Physaria iveyana* is another example of a new, high elevation, narrowly endemic species in a genus that otherwise is mainly limited to lower montane areas, grasslands, pygmy forests, and deserts. High elevation species are few, e.g., *P. alpina* Rollins, *P. humilis* (Rollins) O'Kane & Al-Shehbaz, *P. eriocarpa* Grady & O'Kane, *P. scottiformis* O'Kane all grow from barren or nearly barren outcrops of limestone or dolomite, and most of these were only recently named (Grady & O'Kane 2007; O'Kane 2007; Rollins 1981). The endemic and rare *Heuchera pulchella* Wootton & Standley occupies immediately adjacent habitat of the same limestone on the Sandia Crest but back from the very edge of the escarpment, where it grows from rock cracks (New Mexico Rare Plant Technical Council 2012).

Similar habitat was searched in the Manzano Mountains, but *Physaria iveyana* was not found there. Smaller but otherwise typical individuals of *P. pinetorum* (Wootton & Standl.) O'Kane & Al-Shehbaz were found.

**IUCN Red List category.** *Physaria iveyana* is currently known only from one narrow, approximately 4.5–15 meters wide metapopulation of the Sandia Crest west-facing escarpment. This metapopulation is immediately adjacent to a parking lot, a radio tower facility, and a hiking trail. It is probable that portions of this population have already been lost to activities related to the construction and development of these facilities. Based on the limited aerial extent of the known (and perhaps only) metapopulation of this species, it could be listed according to IUCN Red List criteria (2001) as EN (Endangered) under Criteria B2a and C2a(i).

**Taxonomy.** *Physaria iveyana* is clearly related to *P. pinetorum*, both morphologically and based on preliminary molecular analyses (O'Kane unpublished). In the recent key to *Physaria* of North America (O'Kane 2010, p. 620), *P. iveyana* and *P. pinetorum* can be distinguished by replacing couplet 49 with the following.

49. Stems prostrate; cauline leaves densely overlapping..... 36. *Physaria gordonii* (in part)  
 49. Stems ascending to erect; cauline leaves (relatively few), not or loosely overlapping.
- 49a. Infructescences subumbellate, barely (or not at all) exceeding the basal leaves; plants forming dense mat-like tufts ..... 68. *Physaria pinetorum*  
 49b. Infructescences racemose, elongate and evidently exceeding the basal leaves; plants cespitose, but not forming dense tufts ..... *Physaria iveyana*

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**DIPLACUS BRANDEGEEI (PENNELL) NESOM (PHRYMACEAE)  
IS THE CORRECT NAME FOR THE INSULAR ENDEMIC,  
NOT *DIPLACUS LATIFOLIUS* (A. GRAY) NESOM**

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**ABSTRACT**

*Diplacus latifolius* (A. Gray) Nesom 2012 is a later homonym of *D. latifolius* Nutt. 1838 and is replaced here by *Diplacus brandegeei* (Pennell) Nesom, comb. nov. The species is a member of *Diplacus* sect. *Cleisanthus* and is endemic to islands off the coast of California and Mexico.

In the recent taxonomic overview of Phrymaceae (Barker et al. 2012), one of the new combinations in the genus *Diplacus* was illegitimate, a later homonym. As noted by Dr. James Zarucchi, "*Diplacus latifolius* Nuttall [1838] and now ... (A. Gray) G.L. Nesom [2012]." That error is remedied here with a new, legitimate-name-producing combination.

***Diplacus brandegeei* (Pennell) Nesom, comb. nov.** *Mimulus brandegeei* Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 170. 1947 (as "brandegei"). TYPE: USA. California. Santa Barbara Co.; Santa Cruz Island, 1888, T.S. Brandegee s.n. (holotype: PH; isotypes: CAS digital image!, GH, MIN, MO digital image!, PH, RSA, SD, UC).

*Diplacus latifolius* (A. Gray) Nesom, Phytoneuron 2012-39: 32. 2012, nom. illeg. (not *Diplacus latifolius* Nutt. 1838, see below). *Mimulus latifolius* A. Gray, Proc. Amer. Acad. Arts 11: 95. 1876. *Eunamus latifolius* (A. Gray) Greene, Bull. Calif. Acad. Sci. 1: 99. 1885. TYPE: MEXICO. Baja California. Guadalupe Island, 1875, E. Palmer 58 (holotype: GH; isotypes: BM, K, MO-2 sheets digital images!, NY-2 sheets, PH).

*Diplacus brandegeei* is known only from two of the Channel Islands of California (Santa Catalina Island and Santa Cruz Island) and from Guadalupe Island (Baja California in adjacent Mexico). It is a member of *Diplacus* sect. *Cleisanthus* (Barker et al. 2012).

*Diplacus latifolius* Nutt. (Ann. Hist. Nat. 1: 138. 1838) is a synonym of *D. auranticus* (Curtis) Jepson, a member of *Diplacus* sect. *Diplacus* (Tulig & Nesom 2012).

**ACKNOWLEDGEMENTS**

I'm grateful to Jim Zarucchi for pointing out the nomenclatural error. Citations of types not seen here are from Thompson (2005).

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## NEOTYPIFICATION OF *SOLIDAGO SALICINA* (ASTERACEAE: ASTEREAE) AND A MULTIVARIATE COMPARISON WITH *S. PATULA*

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### ABSTRACT

A neotype specimen is designated for *Solidago salicina* Ell., due to the likely loss or destruction of original material in CHARL. The species was treated as *Solidago patula* Muhl. subsp. *strictula* (Torr. & A. Gray) Semple in Flora North America. Multivariate morphometric analyses of all taxa in *Solidago* subsect. *Argutae* and a comparison of just *S. patula* and *S. salicina* indicate that species rank is warranted for the latter taxon.

**KEY WORDS:** *Solidago salicina*, *Solidago patula*, neotypification, multivariate morphometrics

Weatherby (1942) did not list a type collection for *Solidago salicina* Elliott as occurring in CHARL. A neotype is needed for the species name. Elliott (1824) described the species as having lanceolate scabrous leaves and a racemose inflorescence. He noted it occurred in Georgia and flowered in September and October. The name has been used in floras at the species level (e.g. Small 1903) or as a synonym of *Solidago patula* Muhl var. *strictula* Torr. & A. Gray or *S. patula* Muhl. subsp. *strictula* (Torr. & A. Gray) Semple, e.g., Cronquist (1980) and Semple and Cook (2006), respectively. Both species differ from other taxa in subsect. *Argutae* (Mackenzie in Small) G.L. Nesom in having very small scabrous hairs on the upper leaf surfaces. The results of a multivariate morphometric study of *Solidago* subsect. *Argutae* summarized below clearly indicate that this southeastern USA endemic taxon should be recognized at the species level.

### Neotypification

*Solidago salicina* Ell., Sketch. Bot. S. Carolina 2: 389. 1824. TYPE: USA. Georgia. "Very common in the the oak land in the western districts," Sep-Oct; not listed by Weatherby (1942) as present in CHARL. NEOTYPE (designated here): USA. Georgia. Laurens Co.: swampy places 15 mi E of Dublin, 450 ft, 19 Oct 1947, Cronquist 4880 (GH!). Figure 1.

### Multivariate Analysis

A complete presentation of a multivariate analysis of all taxa in *Solidago* subsect. *Argutae* will be presented elsewhere. Pertinent to this publication are the results of a comparison of *S. patula* and *S. salicina* to each other. The methods followed were those summarized in several other publications on *Solidago* and *Symphyotrichum* (Heard & Semple 1988; Owen, Semple & Baum 2006; Cook, Semple & Baum 2009). In total, more than 200 specimens of taxa in subsect. *Argutae* were scored for 35 vegetative and floral traits. Specimens were obtained from GH, LSU, MO, NCU, NY, USF, and WAT (Thiers, continuously updated).

Discriminant analyses including Stepwise Discriminant Analysis (STEPDISC); Classificatory Discriminant Analysis and Canonical Analysis were performed using SYSTAT ver. 10 (SPSS Inc. 2000) on a data matrix.



Figure 1. Neotype of *Solidago salicina* Ell., Cronquist 4880 (GH).

Two analyses were carried out involving 14 specimens of *Solidago patula* and 13 specimens of *S. salicina*. First, an analysis involving specimens of *S. arguta* (including var. *arguta*, var. *boottii*, var. *caroliniana*), *S. auriculata*, *S. brachyphylla*, *S. faucibus*, *S. harrisi*, *S. ludoviciana*, *S. patula*, *S. salicina*, *S. sphacelata*, *S. tarda*, and *S. verna* was carried out to assess the relative differences between *S. patula* and *S. salicina* compared to other species in the subsection. The full details of this first analysis will be presented elsewhere. Second, an analysis including just specimens of *S. patula* and *S. salicina* was carried out and the results are presented here. Specimens were assigned to two species level *a priori* groups (*patula*, *salicina*) on the basis of geographic location; northern and upland specimens were assigned to the *patula* group, while southern, lower elevation specimens were assigned to the *salicina* group. Specimens of *S. patula* came from Michigan, New York, North Carolina, Ontario, Tennessee, and Virginia. Specimens of *S. salicina* came from Alabama, Florida, Georgia, Louisiana, Mississippi, and North Carolina.

In a STEPDISC analysis of just *Solidago patula* and *S. salicina*, characters were selected as being most useful in separating the two species level *a priori* groups. In a subsequent complete analysis the following characters in order of descending F-to-remove value were used in the discriminant function: upper leaf length, disc floret number, upper leaf width, involucre height, and disc floret pappus length. The null hypothesis that there was only one group was tested using Wilks' lambda, Pillai's Trace and Lawley-Hotelling trace methods, and the null hypothesis was rejected (in each method  $p = 0.0000$ , indicating that the two groups were most likely not samples of the same group).

In the Classificatory Discriminant Analysis, all specimens of *Solidago patula* were placed *a posteriori* in the linear classification analysis into the *patula* group with 98-100% probability for 10 of the 14 specimens. Placement probabilities for three of the specimens ranged from 80-85%. One specimen was placed into the *patula* group with a probability of 69% — *Sample 11576* (WAT) from Polk Co., Tennessee. In the more rigorous Jackknife analysis, 12 of the 14 specimens of *S. patula* were assigned *a posteriori* to the *patula* group.

In the Classificatory Discriminant Analysis, 12 of the 13 specimens of *Solidago salicina* were placed *a posteriori* in the linear classification analysis into the *salicina* group with 97-100% probability for 11 specimens. One specimen was placed into the *salicina* group with a probability of 82%. One specimen was placed into the *patula* group with a probability of 85% — *Godfrey s.n.* (GH) was collected in 1937 from Lead Mines, Raleigh, Wake Co., North Carolina. The specimen had mid stem damage and upper leaf traits were atypical. In the more rigorous Jackknife analysis, 1 of the 14 specimens of *S. patula* were assigned *a posteriori* to the *patula* group, i.e., there was no change from the linear analysis.

### Morphological comparisons

*Solidago patula* and *S. salicina* are similar in being the only two species in subsect. *Argutae* having scabrous upper leaf surfaces with very short hairs, but they differ to varying degrees in other traits. Specimens of *S. salicina* are often more slender and can have more and smaller upper stem leaves than *S. patula*. Both species vary greatly in stem height, which can be as much as 1.3 m. Basal rosette and lower stem leaves are generally longer and have more marginal serrations in *S. patula* than *S. salicina*, but the ranges overlap and the differences are not diagnostic. The difference in lower stem leaf widths is more pronounced with *S. salicina* often having more linear lanceolate leaves. Mid leaf length is similar in the two species, but the leaves are generally shorter and narrower in *S. salicina*. Upper leaves of *S. salicina* can be much smaller than those of *S. patula*, but stem height significantly influences the size of upper leaves, which thus reduces the value of upper leaf size as a diagnostic trait by itself. There is little difference in the numbers of marginal serrations of the middle and upper leaves between the two species.

Involucre height is significantly different although the ranges overlap; mean involucre height in *Solidago patula* is 3.86 mm (range 2.5-6.5 mm); mean involucre height in *S. salicina* is 6.14 mm (range 3.5-8.8 mm). The difference in involucre height is clear in Fig. 2. The phyllaries of *S. patula* are often more obtuse and oblong than those of *S. salicina*. There is little difference in the number of rays, while *S. patula* has an average of 11.8 disc florets per head versus 9.3 disc florets per head in *S. salicina*.



Figure 2. Heads of (A) *Solidago patula* (Semple 10589 WAT) and (B) *Solidago salicina* (Thomas et al. 108382 WAT). Scale bars equal 1 mm.

The ranges in numbers and sizes of leaf and floral traits in the treatment of *Solidago patula* in Flora North America (Semple & Cook 2006) included data on both species. The ranges in character size and number overlap considerably, reducing the value of any character by itself, but in combination with other characters the multivariate analysis shows that two species differ significantly.

### Chromosome numbers

Ploidy level is not a factor in this particular situation. All chromosome counts reported for both *Solidago patula* (Beaudry & Chabot 1959; Beaudry 1963, 1969; Jones 1968; Semple et al. 1981; Morton 1981; Semple et al. 1993; Semple & Cook 2004) and *S. salicina* (Beaudry 1963; Semple et al. 1984, Semple et al. 1993) were diploid,  $2n=18$  or  $2n=9_{II}$ . Thus, the difference in involucre height is not a consequence of the ploidy level gigas effect.

### Conclusion

These results support treating *Solidago salicina* as a species separate from *S. patula*. This fits with the allopatric distribution of the two species (Fig. 3). Also, in the larger subsectional analysis, the specimens of *S. patula* that were assigned *a posteriori* to other species groups were placed in different taxa than those specimens of *S. salicina* that were assigned to other species groups. This indicates that the two species differ in their technical similarities shared with other species in the subsection. Overall within subsect. *Argutae*, species differences are based more on leaf traits than

floral traits other than numbers of ray florets, e.g., few or no rays in *S. sphacelata* and *S. brachyphylla*.

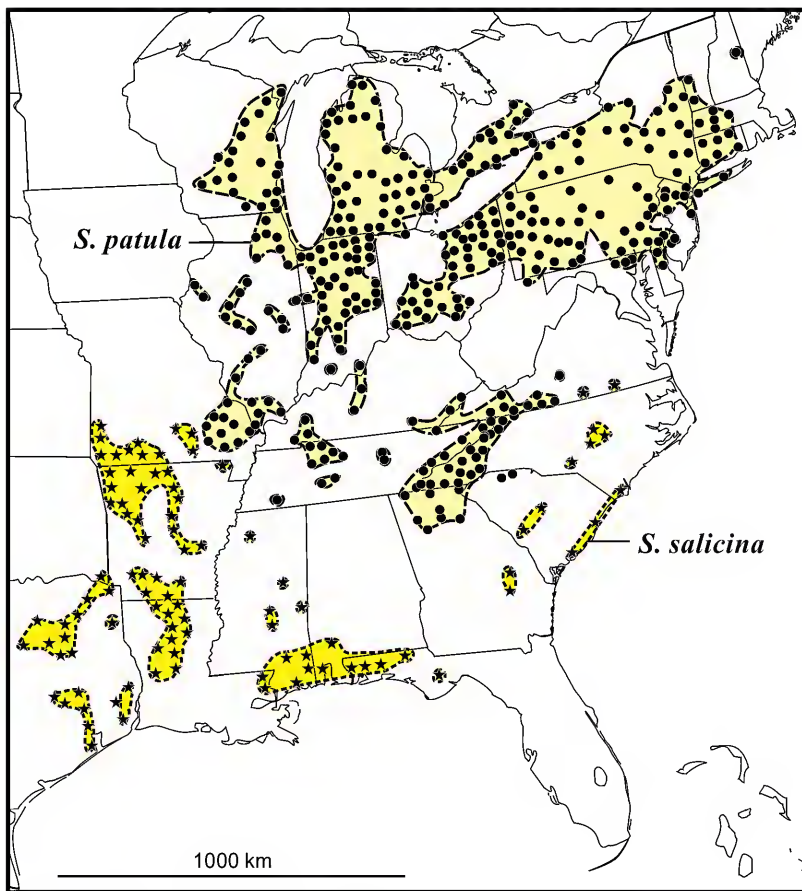


Figure 3. County dot distributions of *Solidago patula* and *S. salicina* based on collections seen and data available online at [plants.usda.gov](http://plants.usda.gov).

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# TAXONOMY AND DISTRIBUTION OF *SENECIO HUACHUCANUS* AND *S. MULTIDENTATUS* (ASTERACEAE)

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## ABSTRACT

The taxonomic status and distribution of *Senecio huachucanus* and *S. multidentatus* is reviewed, largely to determine if the former is properly treated as a variety of the latter, as proposed by Barkley (2006). It is concluded that *S. huachucanus* is a well-demarcated species, represented in at least one herbarium (ARIZ) by numerous collections, all assembled from the Huachuca and Santa Rita Mountains of southeasternmost Arizona. Intergradation between the two species was not detected nor do the two taxa occur together. Surprisingly, a single collection (ASU) of the rare but widespread *S. multidentatus* was discovered, this from the Chiricahua Mountains of Cochise Co., the only known collection from the USA, although the latter occurs sporadically at higher elevations in Mexico. Descriptions of the two taxa are provided along with maps showing their distribution.

**KEY WORDS:** Asteraceae, *Senecio huachucanus*, *Senecio multidentatus*, Arizona, Mexico

*Senecio huachucanus* was first described by Asa Gray in 1883 and typified by a Lemmon collection from high bluffs near Fort Huachuca in southeastern Arizona. Most subsequent workers maintained the species until Barkley (2006) reduced it to varietal rank under his broad circumscription of *S. multidentatus*, this typified by collections from Mount Orizaba (Vera Cruz) in central Mexico. The following key serves to distinguish the two taxa.

1. Involucral bracts 8, 4–5 mm long; disc florets 10–20; USA (Huachuca and Santa Rita Mts., Arizona) and Mexico (Sonora) ..... ***Senecio huachucanus***
1. Involucral bracts 13–21, 6–8 mm long; disc florets 30–numerous; USA (Chiricahua Mts., Arizona) and Mexico (Chihuahua and eastern mountains) ..... ***Senecio multidentatus***

**SENECIO HUACHUCANUS** A. Gray, Proc. Amer. Acad. Arts 9: 54. 1883. *Senecio multidentatus* var. *huachucanus* (A. Gray) T.M. Barkley, Phytologia 67: 238. 1987. **TYPE:** USA. **Arizona.** Cochise Co., near Ft. Huachuca, *Lemmon s.n.* (holotype: GH).

**Perennial** herbs 0.5–1.0 m high. **Mid-stem** leaves mostly 10–20 cm long, 2–7 cm wide, glabrous, petiolate along the lower stems, clasping above; petioles winged, 3–6 cm long, margins irregularly dentate. **Capitulescence** a terminal corymbose panicle ca 10 cm high, and as wide, the ultimate peduncles glabrous, 5–15 mm long. **Heads** narrowly campanulate, 5–6 mm high, 3–4 mm across; involucre bracts 8 (rarely ca 11), united, linear-lanceolate, their apices acute to obtuse, minutely pubescent. **Receptacle** convex, 1–2 mm across, glabrous, epaleate. **Ray florets** 3–8, pistillate, fertile; ligules yellow, 3–9 mm long, 2–3 mm wide, 4–5 nervate. **Disc florets** yellow, glabrous, 10–20 to a head; tubes ca 3 mm long, enlarged at base; throats ca 3 mm long, lobes 5. **Achenes** ca 1.5 mm long, glabrous; pappus of numerous, readily deciduous, white bristles, 4–6 mm long. **Chromosome number** not determined.

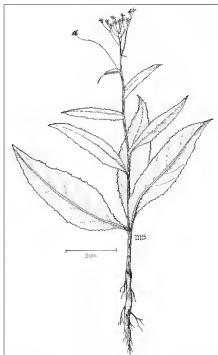


Figure 1. Line drawing of *Senecio huachucae* (ARPC 2001). See color photos at website

**Specimens examined** (all of the following sheets on file at ARIZ): Arizona Cochise Co. Huachuca Mts. W side of Miller Peak, 9000 ft, 26 Aug 1990, *Bowers & McLaughlin 3308*. W slope of Miller Peak, 9200 ft, 1 Sep 1991, *Piskuba 570*. N-facing slope of Ramsey Canyon on trail from Carr Canyon, 7200 ft, 30 Sep 1945, *Greider & Haskell 3362*. Huachuca Mts. Schieffelin Canyon, 7500 ft, 15 Sep 1993 *Muswet s.n.* Miller Peak, 9000 ft, 20 Oct 1990, *Warren & Anderson s.n.* Pima Co.



Santa Rita Mts., below Baldy Saddle and above junction with Super Trail, 8500 ft, 17 Nov 1990, *Stallcup s. n.*; Santa Cruz Co.: Santa Rita Mts., 8000 ft, 23 Aug 1936, *Darrow & Arnold s.n.*; near summit of Mt. Hopkins, 17 Sep 1980, *Fletcher 5050* (TEX); Santa Rita Mts., 23 Aug 1960, *Goodding 247a-60*; trail from Madera Canyon to Mt. Wrightson (Baldy), 9400 ft, 12 Aug 1945, *Parker 5856*; NW slopes of Mt. Wrightson, along trail about 1/8 mile below Bellow's Spring, 8300 ft, at least 500 plants in the area, 3 Oct 1981, *Toolin 1728*; Mt. Wrightson, steep NW-facing slope below Bellow's Spring, at least 500 plants, confined to an area less than 1/4 square mile, 8000-8200 ft, 26 Sep 1987, *Toolin 2216*; Santa Rita Mts., Mt. Hopkins, a few dozen plants on slopes below road, N of Common Building of observatory, 2800 m, 19 Oct 1990, *Toolin & Mc Hargue 2328*.

*Senecio huachucanus* was treated as a good species by Barkley (1978) and listed, early on, as an imperiled species by Toole (1982), this later retracted following additional studies (Gries 1992), presumably, in part, because of Barkley's reassessment (per annotations, and Barkley 2006) that it was but a variety of the widespread *S. multidentatus*. A better candidate for "imperiled status" in Arizona would be the newly discovered *S. multidentatus* population in the Chiricahuas, discussed below, this being a relatively rare taxon throughout its range.

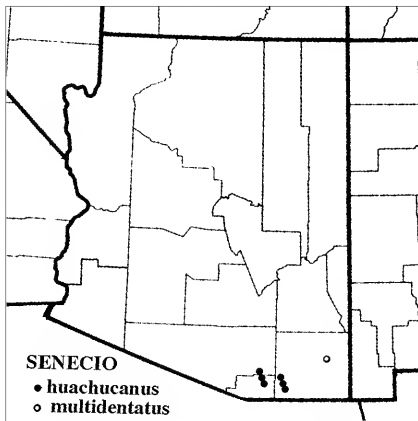


Figure 2. Distribution of *Senecio huachucanus* and *S. multidentatus* in the USA.

**SENECIO MULTIDENTATUS** Sch. Bip. ex Hemsl., Biol. Centr. Amer. Bot. 2: 243.1881. TYPE: MEXICO. **Veracruz** [or **Puebla**]. Mt. Orizaba. (at least 4 syntypes at K, various collectors). *Senecio multidentatus* var. *minor* Hemsl., Biol. Centr. Amer. Bot. 2: 243. 1881. TYPE: MEXICO. **Veracruz** [or **Puebla**]. Mt. Orizaba (several syntypes at K, 3 collectors). *Senecio heterodontus* Greenm., Field Columb. Mus. Bot. 2: 277. 1907. TYPE: MEXICO. **San Luis Potosí**. Alvarez, *Palmer 231* (GH). *Senecio potosinus* Greenm., Monogr. *Senecio* 1: 25: 1901. TYPE: MEXICO: **San Luis Potosí**. Mts. near San Miguelita, *Schaffer 280* (GH).

**Perennial herbs** 0.5–2.0 m high. **Midstem leaves** mostly 15–30 cm long, 3–10 cm wide, closely tomentose to irregularly glabrescent, petiolate along the lower stems, clasping above; petioles winged, 6–20 cm long, margins irregularly dentate. **Capitulescence** a terminal corymbose panicle 20–30 cm high, 10–20 cm wide, tomentose like the stems, the ultimate peduncles 10–25 mm long, to some degree tomentose. **Heads** narrowly campanulate, 8–10 mm high, 6–9 mm across; involucre

bracts 13–21, 5–6 mm long, united, linear-lanceolate, their apices acute to obtuse, minutely pubescent. **Receptacle** convex, 2–4 mm across, glabrous, epaleate. **Ray florets** 8–11, pistillate, fertile; ligules yellow, 6–9 mm long, 2–3 mm wide, 4–5 nerved. **Disc florets** yellow, glabrous, 30–numerous per head; tubes ca 3 mm long, enlarged at base; throats ca 3 mm long, lobes 5. **Achenes** ca 3 mm long, glabrous; pappus of numerous, readily deciduous, white bristles, 4–6 mm long. **Chromosome number** not determined.

The only collection of *Senecio multidentatus* from the USA known to me is from Cochise Co., Chiricahua Mts., Chiricahua Wilderness Area, Snowshed Trail; coniferous forest, 8750 ft, 18 Sep 1976, *Leithliter 829* (ASU). This collection also was mentioned by ARPC (2001) but referred to as var. *huachucanus*. Barkley annotated the sheet in 1998 as *S. multidentatus* var. *huachucanus*, but to me it is much closer to typical *S. multidentatus*.

*Senecio multidentatus* is similar to *S. huachucanus* but is readily distinguished by features given in the above key. So far as known, the two taxa do not grow together, although *S. multidentatus* does occur in the Chiricahua Mountains of Cochise Co. northeast of those in which *S. huachucanus* occurs (Fig. 2). Interestingly, the closest populations of *S. multidentatus* to the Chiricahua site are those from subalpine areas of pine-fir forests (3000–3200 m) on Mt. Mohinora, Chihuahua (e.g., *Nesom 6453*, TEX). Nor has evidence of intergradation been noted.

In short, *Senecio multidentatus* is known only from sporadic, high elevational sites throughout northern Mexico (Fig. 2) and from a single known locality from the USA. It is interesting to speculate that the ancestral populations of *S. multidentatus* that might have given rise to *S. huachucanus* are still represented in Arizona by relic populations in the Chiricahua Mountains. DNA should ultimately help resolve the problem.

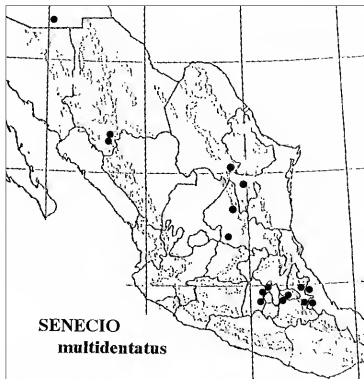


Figure 3 Distribution of *Senecio multidentatus* in Mexico.

## ACKNOWLEDGEMENTS

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## CHECKLIST OF TEXAS GRASS SPECIES AND A KEY TO THE GENERA

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### ABSTRACT

The grass family (Poaceae) is the second largest vascular plant family in Texas. This checklist was created to provide information on the currently known grass species and their distribution in Texas using the 10 vegetational areas for the state. The list provides current scientific names and synonyms as well as common names and an indication of the geographic distribution. The origin (native versus introduced), longevity (perennial versus annual), and season of growth (cool versus warm) are also given for each species. A dichotomous key to the Texas grass genera follows the checklist.

**KEY WORDS:** Poaceae, Texas, species checklist, synonyms, vegetational areas, key to genera



The need for identification and classification of organisms, like grasses, is fundamental to the study of ecology, ecological restoration, forages, and wetlands as well as our immediate surroundings. Communication with other people regarding plants requires more than a simple, "This is buffalograss", with a specimen or image. Plant names, be they common or scientific, are highly important to accurately and quickly communicate knowledge to other people, written or verbally. Checklists have been developed to show species occurrence within certain boundaries or variation within a taxon e.g., "All these are grama grasses."

Texas has about 638 species (Table 1), and about 150 genera of grasses. Table 1 shows a comparison of Gould (1975), Shaw et al. (2011), with our data. Table 2 is a synopsis of our classification, giving the numbers of subfamilies, tribes, genera, and species in the state.

Grass species distributions use the map (Fig. 1) with 10 vegetation areas. These areas are numbered 1-10 and have specific names. The numbers following species in the checklist indicates the distribution of each taxon. For additional information see the following publications and discussions (Cory & Parks 1937; Gould 1962, 1975; Correll & Johnston 1970; Hatch et al. 1990; Powell 1994; Jones et al. 1997; Turner et al. 2003; Shaw et al. 2011).

### VEGETATIONAL AREAS OF TEXAS



Figure 1. Vegetational areas of Texas.

The current checklist and key are based primarily on the large collection of grasses housed in the S.M. Tracy Herbarium (TAES) and thus reflect a larger base of data than in previous summary accounts of the Texas Poaceae. Although we have attempted to provide relevant data on Texas grasses, this publication obviously will be incomplete in various respects. We emphasize the importance of expanding and refining the understanding of the Texas flora. Thus, we welcome and encourage all interested persons to comment and make additions to the database used for this list. We encourage the documentation of new records by specimen vouchers and expect to add many new records as a result of your collections and our verification.

**Table 1. Comparison of selected treatments of Texas Grasses**

	Goulds (1975)	Shaw et al. 2011	This Checklist
Subfamilies	6	8	9
Tribes	21	19	23
Genera	122	181	150
Species	523	721	638

**Table 2. Synopsis of this grass classification**

Subfamilies	Tribes	Genus/Genera	Species
Aristidoideae	1	1	18
Arundinoideae	1	3	4
Bambusoideae	2	3	3
Centothecoideae	1	1	2
Chloridoideae	4	45	215
Danthonioideae	1	2	4
Ehrhartoideae	2	6	11
Panicoideae	2	42	239
Pooideae	9	47	142
<b>Total</b>	<b>23</b>	<b>150</b>	<b>638</b>

This *Checklist of Texas Grasses* summarizes species and distribution data that includes the following information:

1. All species names are in alphabetical order.
2. The distribution for each taxon is summarized by the numbers 1-10, representing the 10 vegetational areas of Texas (Fig. 1). In addition to this see the six areas of the data below.
3. Correct names are in **italics and boldface**. Appropriate synonyms are not in italics or bold and underlined. Synonyms are included in the alphabetical list. The synonyms are followed by parentheses that include an equal (=) sign and where that synonym is now treated as a taxon.
4. Authorities are given for genera, species, subspecies, and varieties (typical subspecies and varieties, called autonyms, do not have authorities).
5. Scientific names and authorities are followed by common names (if available). The first common name of a species is shown in all capital letters, and additional common names appear in lowercase letters. The initial letters of common names for genera, if any, are capitalized. If the common name of a genus is used, the name is abbreviated to its first letter.
6. The codes for origin, longevity, phenology, distribution, and cultivation are given to the right of the accepted species.

**Origin**

N= Native I= Introduced

**Longevity**

A= Annual B= Biennial P= Perennial

**Season of Growth**

W= Warm season C= Cool season

**Cultivated**

CUL

7. Cultivated crops or ornamental taxa are designated with CUL.

The following codes denote plant origin, longevity, season of growth and wetland classification.

Origin: N = Native, I = Introduced

Longevity: A = Annual, B = Biennial, P = Perennial

Season of growth: W = Warm season growth, C = Cool season growth.

Cultivated = CUL

## 2012 Grasses of Texas Checklist

## ACHNATHERUM (=STIPA)

- A. aridum (=Stipa arida)  
A. clandestinum (=Stipa clandestina)  
A. curvifolium (=Stipa curvifolia)  
A. eminens (=Stipa eminens)  
A. hymenoides (=Stipa hymenoides)  
A. lobatum (=Stipa lobata)  
A. nelsonii (=Stipa perplexa)  
A. perplexum (=Stipa perplexa)  
A. robustum (=Stipa robusta)  
A. scribneri (=Stipa scribneri)

## AEGILOPS (=TRITICUM)

- A. cylindrica (=Triticum cylindricum)

## AGROPOGON

- A. littoralis (Sm) C E Hubbard  
 (Agrostis stolonifera × Polypogon monspeliensis) IPW 10

## AGROPYRON Gaertn., Wheatgrass

- A. arizonicum (=Elymus arizonicus)  
A. cristatum (L.) Gaertn., CRESTED W IPC 8 9 10CUL  
A. desertorum (=A. cristatum)  
A. elongatum (=Elymus pontica)  
A. intermedium (=Elymus hispidus)  
A. smithii (=Elymus smithii)  
A. spicatum (=Elymus spicatus)  
A. subsecundum (=Elymus trachycaulus)  
A. trachycaulum (=Elymus trachycaulus)

## AGROSTIS L., Bentgrass

- A. avenacea J Gmel., PACIFIC B. IPC 10  
A. eliottiana Schult., ELLIOTT B., annual ticklegrass NAC 1 2 3 4 7  
A. exarata Trin. SPIKE B. NPC 10  
A. gigantea (=A. stolonifera)  
A. hyemalis (Walt.) B S P., WINTER B., fly-away grass, ticklegrass, spring b. NPC 1 2 3 4 5 6 7 10  
A. perennans (Walt.) Tuckerm., AUTUMN B., perennial b. NPC 1 3  
A. scabra (=A. hyemalis)  
A. semiverticillata (=Polypogon viridis)



<i>A. stolonifera</i> L., REDTOP, creeping b	IPC	2				7	8	10
<i>AIRA</i> L., Hairgrass								
<i>A. caryophyllea</i> L., ANNUAL H	IAC	1	3					
<i>A. elegans</i> (= <i>A. caryophyllea</i> )								
<i>ALLOLEPIS</i> Soder. & H F Deck								
<i>A. texana</i> (Vasey) Soder. & H F Deck	NPW							10
<i>ALOPECURUS</i> L., Foxtail								
<i>A. carolinianus</i> Walt., CAROLINA F	NAC	1	2	3	4	5	7	
<i>A. myosuroides</i> Huds., MOUSE F, slimspike f	IAC	1	2					
<i>AMELICHLOA</i> (= <i>STIPA</i> )								
<i>A. clandestina</i> (= <i>Stipa clandestina</i> )								
<i>ANDROPOGON</i> L., Bluestem								
<i>A. annulatus</i> (= <i>Dichanthium annulatum</i> )								
<i>A. altus</i> (= <i>Bothriochloa alta</i> )								
<i>A. aristatus</i> (= <i>Dichanthium aristatum</i> )								
<i>A. barbinodis</i> (= <i>Bothriochloa barbinodis</i> var. <i>barbinodis</i> )								
<i>A. bladhii</i> (= <i>Bothriochloa bladhii</i> )								
<i>A. caucasicus</i> (= <i>Bothriochloa bladhii</i> )								
<i>A. cirratus</i> (= <i>Schizachyrium cirratum</i> )								
<i>A. divergens</i> (= <i>Schizachyrium scoparium</i> var. <i>divergens</i> )								
<i>A. edwardsianus</i> (= <i>Bothriochloa edwardsiana</i> )								
<i>A. elliotii</i> of Texas auth., not Chapm. (= <i>A. gyrans</i> )								
<i>A. exaristatus</i> (= <i>Bothriochloa exaristata</i> )								
<i>A. frequens</i> (= <i>Schizachyrium scoparium</i> var. <i>scoparium</i> )								
<i>A. gerardii</i> Vitman, BIG B.								
var. <i>chrysocomus</i> (Nash) Fern., BIG B.	NPW						8	9 10
var. <i>gerardii</i> BIG B., turkey-foot	NPW	1	2	3	4	5	6	7 8 9 10
var. <i>paucipilus</i> (Nash) Fern., SAND B.	NPW							8 9 10
<i>A. glomeratus</i> (Walt.) B S.P., BUSHY B., bushy beardgrass	NPW	1	2	3	4	5	6	7 8 9 10
<i>A. gyrans</i> Ashe ELLIOTT'S B., Elliott beardgrass	NPW	1	2	3				
<i>A. hallii</i> (= <i>A. gerardii</i> var. <i>paucipilus</i> )								
<i>A. hirtiflorus</i> (= <i>Schizachyrium sanguineum</i> var. <i>hirtiflorum</i> )								
<i>A. hybridus</i> (= <i>Bothriochloa hybrida</i> )								
<i>A. intermedia</i> (= <i>Bothriochloa bladhii</i> )								

A. ischaemum var. songaricus (= *Bothriochloa ischaemum*)

A. littoralis (= *Schizachyrium scoparium* var. *littoralis*)

A. longipaniculata (= *Bothriochloa laguroides* subsp. *torreyana*)

A. neomexicanum (= *Schizachyrium neomexicanum*)

A. nodosus (= *Dichanthium aristatum*)

A. perforatus (= *Bothriochloa barbinodis*)

A. pertusus (= *Bothriochloa pertusa*)

A. saccharoides var. torreyanus (= *Bothriochloa laguroides* subsp. *torreyana*)

A. scoparium var. divergens (= *Schizachyrium scoparium* var. *divergens*)

A. scoparium var. virilis (= *Schizachyrium scoparium* var. *divergens*)

A. sericeus (= *Dichanthium sericeum*)

A. spadiceus (= *Schizachyrium spadiceum*)

A. springfieldii (= *Bothriochloa springfieldii*)

A. ternarius Michx. SPLITBEARD B., splitbeard beardgrass, silvery beardgrass, feather b. NPW 1 2 3 4 5 10

A. virginicus L., BROOMSEDGE B., yellow sedge b., Virginia b., broomsedge NPW 1 2 3 4 5 6 7

A. virginicus var. abbreviatus (= *A. glomeratus*)

A. wrightii (= *Bothriochloa wrightii*)

#### ANISTANTHA (= *BROMUS*)

A. diandrus (= *Bromus diandrus*)

A. rubens (= *Bromus rubens*)

A. sterilis (= *Bromus sterilis*)

A. tectorum (= *Bromus tectorum*)

#### ANTHAENANTIA P. Beauv., Silky scale

A. rufa (Ell.) Schult., PURPLE S. NPW 1 2

A. villosa (Michx.) P. Beauv., GREEN S., purple s. NPW 1 2 3

#### ANTHOXANTHUM L., Vernalgrass

A. aristatum Boiss., SMALL SWEET V., v. IAC

A. odoratum L., SWEET V. IPC

#### APERA Adans

A. spica-venti (L.) P. Beauv., LOOSE SILKYBENT, windgrass IAC 4

*ARISTIDA* L., Threawn

<i>A. adscensionis</i> L., SIXWEEKS T	NAW	6	7	8	9	10
<i>A. affinis</i> (= <i>A. palustris</i> )						
<i>A. arizonica</i> Vasey, ARIZONA T	NPW					10
<i>A. barbata</i> (= <i>A. havardii</i> )						
<i>A. basiramea</i> Engelm. ex Vasey, FORKTIP T.	NAW	3	4			
<i>A. brownii</i> (= <i>A. purpurea</i> )						
<i>A. desmantha</i> Trin. & Rupr., CURLY T., western tripleawn grass, western t.	NAW	6	7	8	9	10
<i>A. dichotoma</i> Michx., CHURCHMOUSE T., povertygrass	NAW	1	3	4		
<i>A. divaricata</i> Humb. & Bonpl. ex Willd., POVERTY T.	NPW				7	9 10
<i>A. fendleriana</i> (= <i>A. purpurea</i> var. <i>fendleriana</i> )						
<i>A. glauca</i> (= <i>A. purpurea</i> var. <i>nealleyi</i> )						
<i>A. gypsophila</i> Beetle, GYP T.	NPW					10
<i>A. hamulosa</i> (= <i>A. ternipes</i> )						
<i>A. havardii</i> Vasey, HAVARD T.	NPW					9 10
<i>A. intermedia</i> (= <i>A. longespica</i> var. <i>geniculata</i> )						
<i>A. lanosa</i> Muhl. ex Ell., WOOLLYSHEATH T., woolly tripleawn grass, woolly t.	NPW	1	2	3	4	
<i>A. longiseta</i> (= <i>A. purpurea</i> var. <i>longiseta</i> )						
<i>A. longiseta</i> var. <i>rariflora</i> (= <i>A. purpurea</i> var. <i>longiseta</i> )						
<i>A. longiseta</i> var. <i>robusta</i> (= <i>A. purpurea</i> var. <i>longiseta</i> )						
<i>A. longespica</i> Poir., SLIMSPIKE T.						
var. <i>geniculata</i> (Raf.) Fern., KEARNEY T., plains t.	NAW	1	2	3	4	5 6 7
var. <i>longespica</i> , SLIMSPIKE T., slender t.	NAW	1	2	3	4	
<i>A. oligantha</i> Michx., OLDFIELD T., prairie t., few-flowered aristida <i>A. orcuttiana</i> (= <i>A. schiediana</i> )	NAW	1	2	3	4	5 6 7 8 9 10
<i>A. palustris</i> (Chapm.) Vasey, LONGLEAF T.	NPW	1				
<i>A. pansa</i> Woot. & Standl., WOOTEN T.	NPW					7 10
	NPW	1	2	3	4	7
<i>A. purpurascens</i> Poir., ARROWFEATHER T., broomsedge, arrowgrass						
<i>A. purpurea</i> Nutt.	NPW					10
var. <i>fendleriana</i> (Steud.) Vasey, FENDLER T.						
var. <i>laxiflora</i> (= <i>A. purpurea</i> var. <i>purpurea</i> )						

var. <i>longiseta</i> (Steud.) Vasey, RED T., dogtown-grass,	NPW	2	4	5	6	7	8	9	10
var. <i>nealleyi</i> (Vasey) Allred, NEALLEY T.	NPW			5	6	7	8	9	10
var. <i>purpurea</i> , PURPLE T., purple needlegrass	NPW	2	4	5	6	7	8	9	10
var. <i>wrightii</i> (Nash) Allred, WRIGHT'S T.	NPW		4	5	6	7	8	9	10
<i>A. ramosissima</i> Engelm. ex A. Gray, S-CURVE T.	NAW	1				7			
<i>A. roemeriana</i> (= <i>A. purpurea</i> var. <i>purpurea</i> )									
<i>A. schiedeana</i> Trin. & Rupr., SINGLEAWN ARISTIDA, beggarstick t., Orcutt's t.	NPW								10
<i>A. ternipes</i> Cav.									
var. <i>gentilis</i> (Hendr.) Allred, HOOK T.	NPW								10
var. <i>ternipes</i> , SPIDERGRASS	NPW								10
<i>A. virgata</i> (= <i>A. purpurascens</i> )									
<i>A. wrightii</i> (= <i>A. purpurea</i> var. <i>wrightii</i> )									
<i>ARTHRAOXON</i> P. Beauv.									
<i>A. hispidus</i> (Thunb.) Makino, JOINTHEAD	IAW	1			5				
<i>ARUNDINARIA</i> Michx.									
<i>A. gigantea</i> (Walt.) Muhl., GIANTCANE, southern cane	NPC	1	2	3	4	5		7	10
<i>A. tecta</i> (= <i>A. gigantea</i> )									
<i>ARUNDO</i> L.									
<i>A. donax</i> L., GIANTREED	IPW		2	3	4	5	6	7	8 9 10 CUL
<i>AVENA</i> L., Oat									
<i>A. fatua</i> L.									
var. <i>fatua</i> , WILD O.	IAC		2	3			7	8	9 10
var. <i>sativa</i> (L.) Hausskn., O., cultivated o	IAC	1	2	3	4	5	6	7	8 9 10 CUL
<i>A. sativa</i> (= <i>A. fatua</i> var. <i>sativa</i> )									
<i>AXONOPUS</i> P. Beauv., Carpetgrass									
<i>A. affinis</i> (= <i>A. fissifolius</i> )									
<i>A. compressus</i> (Sw.) P. Beauv., BROADLEAF C.	NPW	1	2						
<i>A. fissifolius</i> (Raddi) Kuhlman, COMMON C.	NPW	1	2	3					
<i>A. furcatus</i> (Flügge) A. Hitchc., BIG C., flat crabgrass	NPW	1	2	3					
<i>BLEPHARIDACHNE</i> Hack.									
<i>B. bigelovii</i> (S. Wats.) Hack., BIGELOW DESERTGRASS	NPW								10

**BLEPHARONEURON** Nash

*B. tricholepis* (Torr.) Nash, PINE DROPSEED, NPW 10  
hairy dropseed

**BOTHRIOCHLOA** Kuntze, Bluestem

*B. alta* (A. Hitchc.) Henr., TALL B. NPW 10

*B. barbinodis* (Lag.) Hert., CANE B

var *barbinodis*, CANE B, cane NPW 2 5 6 7 8 9 10  
beardgrass, bristlejoint b.

var *perforata* (Fourn.) Gould, NPW 2 5 6 7 8 9 10  
PINHOLE B., pinhole beardgrass,  
perforated b.

*B. bladhii* (Retz.) S. T. Blake, AUSTRALIAN B. IPW 2 3 6

*B. caucasica* (= *B. bladhii*)

*B. edwardsiana* (Gould) L. R. Parodi, MERRILL'S B. NPW 7

*B. exaristata* (Nash) Henr., AAWNLESS B. NPW 2

*B. hybrida* (Gould) Gould, HYBRID B. NPW 2 6 7

*B. intermedia* (= *B. bladhii*)

*B. ischaemum* (L.) Keng, KING RANCH B. IPW 1 2 3 4 5 6 7 8 9 10

*B. laguroides* (DC.) Hert. NPW 1 2 3 4 5 6 7 8 9 10  
subsp. *torreyana* (Steud.) Allred &  
Gould, SILVER B., silver beardgrass

*B. longipaniculata* (= *B. laguroides* subsp. *torreyana*)

*B. pertusa* (L.) A. Camus, PITTED B. IPW 6

*B. sachharoides* var. *torreyana* (= *B. laguroides* subsp. *torreyana*)

*B. springfieldii* (Gould) L. R. Parodi, NPW 9 10  
SPRINGFIELD B.

*B. wrightii* (Hack.) Henr., WRIGHT'S B. NPW 10

**BOUTELOUA** Lag. *mut.* Lag., Grama

*B. aristidoides* (Kunth) Griesb. NAW 6 7 10

var *aristidoides*, NEEDLE G., sixweek  
g.

var. *arizonica* (M. E. Jones) Allred

*B. barbata* Lag., SIXWEEKS G. NAW 1 2 3 4 5 6 7 8 9 10

*B. breviseta* Vasey, GYP G. NPW 10

*B. chondrosioides* (Kunth) Benth. ex S. Wats., NPW 10  
SPRUCETOP G.

*B. curtipendula* (Michx.) Torr.

var *caespitosa* Gould & Kapadia, NPW 5 6 7 10  
SIDEOATS G.

var. *curtipendula*, SIDEOATS G. NPW 2 3 4 5 6 7 8 9 10

var. *tenuis* Gould & Kapadia, IPW 7  
CREEPING SIDEOATS G.

*B. dactyloides* (= *Buchloe dactyloides*)

<i>B. eriopoda</i> (Torr.) Torr., BLACK G., woollyfoot g	NPW						7	8	9	10
<i>B. gracilis</i> (Kunth) Lag., ex Griffiths, BLUE G.	NPW					5	7	8	9	10
<i>B. hirsuta</i> Lag., HAIRY G.	NPW	1	2	3	4	5	6	7	8	9
<i>B. kayii</i> Warnock, KAY G.	NPW							7		10
<i>B. pectinata</i> Featherly, TALL G.	NPW							7		10
<i>B. ramosa</i> Scribn. ex Vasey, CHINO G.	NPW								9	10
<i>B. repens</i> (Kunth) Scribn. & Merr., SLENDER G., large-mesquite g.	NPW						6	7		
<i>B. rigidiset</i> a (Steud.) A. Hitchc.										
var <i>rigidiseta</i> , TEXAS G., mesquitegrass	NPW		2	3	4	5	6	7	8	9
<i>B. simplex</i> Lag., MAT G.	NAW									10
<i>B. trifida</i> Thurb. ex S. Wats., RED G., threeawn g.	NPW		2	3		5	6	7	8	9
var <i>trifida</i>										
<i>B. uniflora</i> Vasey, NEALLEY G., one-flowered g.	NPW							7		10
<i>B. warnockii</i> Gould & Kapadia, WARNOCK G.	NPW									10
<b>BRACHIARIA</b> (Trin.) A. Griseb., Signalgrass										
<i>B. arizonica</i> (= <i>Urochloa arizonica</i> )										
<i>B. brizantha</i> (= <i>U. brizantha</i> )										
<i>B. ciliatissima</i> (= <i>U. ciliatissima</i> )										
<i>B. eruciformis</i> (J. E. Smith) A. Griseb.	IAW							7		
<i>B. fasciculata</i> (= <i>U. fusca</i> )										
<i>B. mutica</i> (= <i>U. mutica</i> )										
<i>B. plantaginea</i> (= <i>U. platyphylla</i> )										
<i>B. platyphylla</i> (= <i>U. platyphylla</i> )										
<i>B. ramosa</i> (= <i>U. fasciculata</i> )										
<i>B. reptans</i> (= <i>U. reptans</i> )										
<i>B. texana</i> (= <i>U. texana</i> )										
<b>BRACHYELYTRUM</b> P. Beauv.										
<i>B. erectum</i> (Schreb. ex Spreng.) P. Beauv., SOUTHERN SHORTHUSK	NPC	1								
<b>BRACHYPODIUM</b> P. Beauv.										
<i>B. distachyon</i> (L.) P. Beauv., PURPLE FALSEBROME	IAC					5		7		
<b>BRIZA</b> L., Quakinggrass										
<i>B. maxima</i> L., BIG Q.	IAC	1	2							
<i>B. minor</i> L., LITTLE Q.	IAC	1	2	3	4					CUL



*BUCHLOË* Engelm.

<i>B. dactyloides</i> (Nutt.) Engelm., BUFFALOGRASS	NPW	1	2	3	4	5	6	7	8	9	10
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*CALAMOVILFA* (A. Gray) Hack

<i>C. gigantea</i> (Nutt.) Scribn. & Merr. BIG SANDREED, giant reedgrass	NPW								8	9	10
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*CATAPODIUM* Link (= *DESMAZERIA*)

*C. rigidum* (= *Desmazeria rigida*)

*CATHESTECUM* J. Presl

<i>C. erectum</i> Vasey & Hack., FALSE GRAMA	NPW							7			10
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*CENCHRUS* L., Sandbur, Cenchrus

<i>C. brownii</i> Roem. & Schult., GREEN S	IPW							6			
<i>C. ciliaris</i> (= <i>Pennisetum ciliare</i> )											
<i>C. echinatus</i> L., SOUTHERN S., hedge-hog grass	NAW	1	2	3	4			6			
<i>C. incertus</i> (= <i>C. spinifex</i> )											
<i>C. longespinus</i> (Hack.) Fern., LONGSPINE S.	NAW				3	4	5	6	7	8	9
<i>C. myosuroides</i> Kunth, BIG C., big sandbur, cadillo	NPW		2					6	7		10
<i>C. pauciflorus</i> (= <i>C. spinifex</i> )											
<i>C. setigerus</i> (= <i>Pennisetum setigerum</i> )											
<i>C. spinifex</i> A. Cav., COMMON S.	NPW	1	2	3	4	5	6	7	8	9	10

*CERATOCHLOA* (= *BROMUS*)

<i>C. carinata</i> (= <i>Bromus carinatus</i> )											
<i>C. catharticus</i> (= <i>Bromus catharticus</i> )											
<i>C. polyantha</i> (= <i>Bromus polyanthus</i> )											

*CHASMANTHIUM* Link, Woodoats

<i>C. latifolium</i> (Michx.) H. Yates, BROADLEAF W.	NPW	1	2	3	4	5	6	7	8		
<i>C. laxum</i> (L.) H. Yates, NARROWLEAF W.	NPW	1	2	3	4						
<i>C. sessiliflorum</i> (= <i>C. laxum</i> )											

*CHLORIS* Sw., Windmillgrass, Chloris

<i>C. andropogonoides</i> E. Fourn., SLIMSPIKE W.	NPW		2						7		
<i>C. barbata</i> (L.) Sw., SWOLLEN W.	NAW		2								
<i>C. x brevispica</i> ( <i>C. x subdolichostachya</i> )											
<i>C. canerae</i> Archav., PARAGUAYAN W.	IPW			2	3			6	7		
<i>C. chloridea</i> (= <i>Enteropogon chlorideus</i> )											
<i>C. ciliata</i> Sw., FRINGED C.	NPW		2					6	7		





*CORTADERIA* Stapf

- C. jubata* (Lemoine ex Carriere) Stapf, PURPLE IPW  
PAMPUSGRASS
- C. selloana* (Schult. & Schult. f.) Asch. & Graebn., IPW 1 2 3 4 5 6 7 8 9 10 CUL  
PAMPASGRASS

*COTTEA* Kunth

- C. pappophoroides* Kunth, COTTAGRASS NPW 7 10

## CRITESION (=HORDEUM)

- C. jubatum* (=Hordeum jubatum)
- C. murinum* (=Hordeum murinum)
- C. pusillum* (=Hordeum pusillum)

*CTENIUM* Panz., TOOTHACHEGRASS

- C. aromaticum* (Walt.) A. Wood, NPW 1  
TOOTHACHEGRASS, orangegrass

*CYNODON* L. Rich., Bermudagrass

- C. aethiopicus* Clayton & Harlan, ETHIOPIAN IPW  
DOGTUOTHGRASS CUL
- C. dactylon* (L.) Pers., B. pata del gallo, common IPW 1 2 3 4 5 6 7 8 9 10  
b. CUL
- C. x magennisii* Hurcombe, MAGENNIS IPW  
DOGTUOTH GRASS CUL
- C. nlemfuensis* Vanderyst, AFRICA B. IPW 2 6 CUL
- C. plectostachyus* (K. Schum.) Pilg., IPW 6 CUL  
STARGRASS

*CYNOSURUS* L.

- C. echinatus* L., BRISTLY DOGTAIL IAC 3

*DACTYLIS* L.

- D. glomerata* L., ORCHARDGRASS IPC 1 2 7 9 10  
CUL

*DACTYLOCTENIUM* Willd.

- D. aegyptium* (L.) Willd., DURBAN IAW 1 2 3 4 5 6 7  
CROWFOOTGRASS, Egyptian crowfootgrass

*DANTHONIA* DC., Danthonia, Oatgrass

- D. sericea* Nutt., DOWNY O. NPC 1
- D. spicata* (L.) P. Beauv. ex Roem. & Schult., NPC 1 3 5  
POVERTY O., poverty d.

*DASYOCHLOA* Willd. ex Rydb.

- D. pulchella* (Kunth) Willd. ex Rydb., NPW 7 8 9 10  
FLUFFGRASS

*DESMAZERIA* Dumort

*D. rigida* (L.) T. Tutin, STIFFGRASS IAC 1 2 3 4 5 6 7

*DIARRHENA* P. Beauv.

*D. americana* (of TX authors (= *D. obovata*))

*D. obovata* (Gleason) A. Brandenburg, NPC 1  
AMERICAN BEAKGRAIN

*DICHANTHELIUM* (A. Hitchc. & Chase) Gould, Rosettegrass

*D. aciculare* (Desv. ex Poir.) Gould & C. Clark

var. *aciculare*, NARROW-LEAF R. NPC 1 2 3 4

var. *angustifolium* (Ell.) Freckmann & NPC  
Lelong

*D. acuminatum* (Sw.) Gould & C. Clark

var. *acuminatum*, WOOLLY R. NPC 1 2 3 4 5 6 7 8 10

var. *densiflorum* (Rand & Redf.) Gould NPC 2  
& C. Clark

var. *lindheimeri* (Nash) Gould & C. NPC 1 2 3 4 5 7  
Clark, LINDHEIMER R.

var. *longiligulatum* (Nash) Gould & C. NPC 1  
Clark

var. *villosum* (Sw.) Gould & C. NPC 1 3 5  
Clark, WHITEHAIRD R.

*D. angustifolium* (= *D. aciculare*)

*D. boscii* (Poir.) Gould & C. Clark, BOSC'S R. NPC 1 2 3

*D. clandestinum* (L.) Gould, DEERTONGUE R. NPC 1 3

*D. commutatum* (Schult.) Gould, VARIABLE R. NPC 1 2

*D. consanguineum* (Kunth) Gould & C. Clark, NPC 1 2  
KUNTH'S R.

*D. depauperatum* (Muhl.) Gould, STARVED R. NPC 1

*D. dichotomum* (L.) Gould, FORKED R.

var. *dichotomum* NPC 1 2 3 4 5

var. *ensifolium* (= *D. ensifolium*)

var. *lucidum* (Ashe) Freckmann & NPC  
Lelong

var. *nitidum* (Lam.) Freckmann & Lelong NPC

var. *ramulosum* (Torr.) LeBlond NPC

var. *uncephyllum* (Trin.) Davidse NPC

*D. ensifolium* (Baldw. ex Ell.) Gould BOG R. NPC 1

*D. lanuginosum* (= *D. acuminatum* var. NPC  
*acuminatum*)

*D. latifolium* (L.) Harvil, BROADLEAF R. NPC 1

*D. laxiflorum* (Lam.) Gould, OPENFLOWER R. NPC 1 3

*D. leucoblepharis* (= *D. strigosum*)

*D. lindheimeri* (= *D. acuminatum* var. *lindheimeri*)





*ELEUSINE* Gaertn., Goosegrass

*E. indica* (L.) Gaertn., G., yardgrass, zacate guacima IAW 1 2 3 4 5 6 7 8 9 10

*E. tristachya* (Lam.) Lam., THREESPIKE G IAW 3

*ELIONURUS* Humb. & Bonpl. ex Willd., Balsamscale

*E. barbiculmis* Hack., WOOLSPIKE B., bristlenode b. NPW 10

*E. tripsacoides* Humb. & Bonpl. ex Willd., PAN AMERICAN B., b. NPW 2 6

*ELYMUS* L., Wildrye, Wheatgrass

*E. arizonicus* (Scribn. & J. G. Smith) Gould, ARIZONA WHEATGRASS NPC 10

*E. canadensis* L.

var. *canadensis*, CANADA WILDRYE, nodding wildrye NPC 1 2 3 4 5 7 8 9 10

*E. curvatus* (= *E. virginicus*)

*E. elymoides* (= *E. longifolius*)

*E. elongatus* (= *E. ponticus*) IPC 9 10

*E. glabriflorus* (= *E. virginicus*)

*E. hispidus* (P. Opiz) Melderis, INTERMEDIATE WHEATGRASS IPC 9 10 CUL

*E. interruptus* (= *E. canadensis*)

*E. junceus* (= *Psathrostachys juncea*)

*E. macgregorii* (= *E. virginicus*)

*E. longifolius* (J. G. Smith) Gould, LONGLEAF SQUIRRELTAIL NPC 7 8 9 10

*E. ponticus* (Podp.) Melderis, TALL WHEATGRASS IPC 8 9 CUL

*E. pringlei* (= *E. canadensis*)

*E. repens* (L.) Gould, QUACKGRASS IPC 9 10

*E. smithii* (Rydb.) Gould, WESTERN WHEATGRASS NPC 5 7 8 9 10

*E. spicatus* (Pursh) Gould, BLUEBUNCH WHEATGRASS NPC 10

*E. texensis* (? hybrid)

*E. trachycaulus* (Link) Gould ex Shimmers, SLENDER WHEATGRASS NPC 8 9 10

*E. triticoides* (= *Leymus triticoides*)

*E. villosus* Muhl. ex Willd., DOWNY WILDRYE NPC 6 7

*E. virginicus* L., VIRGINIA WILDRYE NPC 1 2 3 4 5 6 7 8

ELYTRIGIA (=ELYMUS)

*E. arizonica* (= *Elymus arizonicus*)

E intermedia (= *Elymus hispidus*)

*E. pontica* (= *Elymus elongatus*)

*E. smithii* (= *Elymus smithii*)

*ENNEAPOGON* Desv. ex P. Beauv., Pappusgrass

<i>E. desvauxii</i> P Beauv , FEATHER P, spike p, Wright's p	NPW	7	8	9	10
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*ENTEROPOGON* Nees. Umbrellagrass

<i>E. chlorideus</i> (J Presl) W. Clayton, BURYSEED	NPW	2	4	6
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*ERAGROSTIS* Wolf. Lovegrass

<i>E. airoides</i> Nees.	ILLUSIONGRASS	IPW	3
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<i>E. amabilis</i> (L.) Wight & Arnolt ex Nees,	IAW	1	2
JAPANESE L.			

*E. arida* (= *E. pectinacea* var. *miserrima*)

<i>E. barrelieri</i> Daveau.	MEDITERRANEAN L.	IAW	2	3	4	5	6	7	8	9	10
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*E. beyrichii* (= *E. secundiflora*)

<i>E. capillaris</i> (L.) Nees.	LACEGRASS, tiny 1	NAW	2	3	8
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<i>E. cilianensis</i> (All.) Vignola ex Janchen, STINKGRASS	IAW	1	2	3	4	5	6	7	8	9	10
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*E. ciliaris* (L.) R. Br. GOPHERTAIL L. NAW 2

<i>E. curtipedicellata</i> Buckl., GUMMY L., shortstalked l.	NPW	1	2	3	4	5	6	7	8	9	10
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<i>E. curvula</i> (Schrad.) Nees, WEEPING L	IPW	2	3	4	5	7	8	9	10	CUL
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E. diffusa (= *E. pectinacea* var. *pectinacea*)

<i>E. elliottii</i> S. Wats., ELLIOTT L.	NPW	1	2	3
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<i>E. erosa</i> Scribn., CHIHUAHUA L.	NPW	7	10
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*E. glomerata* (= *E. japonica*)

<i>E. hirsuta</i> (Michx.) Nees.	BIGTOP L.	NPW	1	2	3
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<i>E. hypnoides</i> (Lam.) Britt., TEAL L, smooth creeping grass	NAW	1	2	3	4	5	7
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<i>E. intermedia</i> A. Hitchc.	NPW	2	3	4	5	6	7	10
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var *intermedia*, PLAINS L

*E. japonica* (Thunb.) Trin. POND L. NAW

<i>E. lehmanniana</i> Nees, LEHMANN L.	IPW	3	4	5	6	10
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<i>E. lugens</i> Nees, MOURNING L	NPW	6 7
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*E. megastachya* (= *E. cilianensis*)

<i>E. mexicana</i> (Hornem.) Link			
subsp. <i>mexicana</i> . MEXICAN L.	NAW		10





<i>E. contracta</i> A Hitchc., PRAIRIE C.	NAW	1	2	3	4	5	6	7	8	9
<i>E. gracilis</i> (= <i>E. acuminata</i> var. <i>acuminata</i> )										
<i>E. gracilis</i> var. <i>minor</i> (= <i>E. acuminata</i> var. <i>minor</i> )										
<i>E. polystachya</i> Kunth, CARIBBEAN C.	IPW		2							
<i>E. pseudoacroticha</i> (Stapf ex Thell.) J M Blake, VERNAL C.	IPW		2				6			
<i>E. punctata</i> (L.) Desv. ex Hamilton, LOUISIANA C., everlasting-grass	NPW		2				6			
<i>E. sericea</i> (Scheele) Munro ex Vasey, TEXAS C., silky c.	NPW		2		4	5	6	7	8	10
<i>ERIONEURON</i> Nash, Erioneuron, Woollygrass										
<i>E. avenaceum</i> (Kunth) Tateoka, LARGEFLOWERED E.	NPW							7		10
<i>E. grandiflora</i> (= <i>E. avenaceum</i> )										
<i>E. nealleyi</i> (Vasey) Tateoka, NEALLEY'S E.	NPW									10
<i>E. pilosum</i> (Buckl.) Nash, HAIRY E., hairy tridens	NPW		2		4	5	6	7	8	9
<i>E. pulchellum</i> (= <i>Dasyochloa pulchella</i> )										
<i>EUCHLAENA</i> (= <i>ZE4</i> )										
<i>E. perennis</i> (= <i>Zea perennis</i> )	IPW		2							
<i>EUSTACHYS</i> Desv., Fingergrass										
<i>E. caribea</i> (Spreng.) Herter, CHICKENFOOTGRASS	IPW				3					
<i>E. neglecta</i> (Nash) Nash, FOURSPIKE F.	IPW				3					
<i>E. petraea</i> (Sw.) Desv., STIFFLEAF F.	NPW		2	3	4					
<i>E. retusa</i> (Lag.) Kunth, F.	NPW				3	4				
<i>FESTUCA</i> L., Fescue										
<i>F. arizonica</i> Vasey, ARIZONA F., canuela borreguera	NPC									10
<i>F. arundinacea</i> (= <i>Schedonorus arundinaceus</i> )										
<i>F. dertonensis</i> (= <i>Vulpia bromoides</i> )										
<i>F. ligulata</i> Swallen, GUADALUPE F.	NPC									10
<i>F. megalura</i> (= <i>Vulpia myuros</i> var. <i>hirsuta</i> )										
<i>F. myuros</i> (= <i>Vulpia myuros</i> var. <i>myuros</i> )										
<i>F. obtusa</i> (= <i>F. subverticillata</i> )										
<i>F. octoflora</i> (= <i>Vulpia octoflora</i> var. <i>octoflora</i> )										
<i>F. paradoxa</i> Desv., CLUSTER F.	NPC		1		3					
<i>F. pratensis</i> (= <i>Schedonorus arundinaceus</i> )										
<i>F. rubra</i> L., RED F.	NPC									10
<i>F. sciurea</i> (= <i>V. sciurea</i> )										
<i>F. subverticillata</i> (Pers.) E. Alexeev, NODDING B.	NPC		1	2	3					

<i>F. versuta</i> Beal, TEXAS F	NPC	7			
<i>GASTRIDIMUM</i> P. Beauv					
<i>G. phleoides</i> (Nees & Meyer) C. E. Hubb., NITGRASS	IAC				10
<i>G. ventricosum</i> (= <i>G. phleoides</i> )					
<i>GLYCERIA</i> R. Br., Mannagrass					
<i>G. arkansana</i> (= <i>G. septentrionalis</i> var. <i>arkansana</i> )					
<i>G. declinata</i> Breh., LOW M.	IPC	1			
<i>G. grandis</i> S. Wats., NOT VERIFIED					
<i>G. notata</i> Chevall., NOT VERIFIED					
<i>G. septentrionalis</i> A. Hitchc., EASTERN M., floating m					
var <i>arkansana</i> (Fern.) Steyerl. & Kucera, ARKANSAS M.	NPC	1			
var <i>septentrionalis</i> , EASTERN M., floating m	NPC	1	2	3	
<i>G. striata</i> (Lam.) A. Hitchc., FOWL M., nerved m.	NPC		3	4	7 10
<i>GYMNOPOGON</i> P. Beauv., Skeletongrass					
<i>G. ambiguus</i> (Michx.) B. S. P., BEARDED S., broad-leaved beardgrass	NPW	1	2	3	5
<i>G. brevifolius</i> Trin., SHORTLEAF S.	NPW			3	
<i>HACHELOCHLOA</i> (= <i>MNESITHEA</i> )					
<i>H. granularis</i> (= <i>Mnesithea granularis</i> )					
<i>HAINARDIA</i> Greuter					
<i>H. cylindrica</i> (Willd.) W. Greuter THINTAIL	IAC	2			
<i>HEMARTHRIA</i> R. Br.					
<i>H. altissima</i> (Poir.) Stapf & C. E. Hubb., LIMPOGRASS	IPW	2		6	10
<i>HESPEROSTIPA</i> (Elias) Barkworth, Needlegrass					
<i>H. comata</i> (Trin. & Rupr.) M. Barkworth, NEEDLE-AND-THREAD	NPW			8	9 10
<i>H. neomexicana</i> (Thurb.) M. Barkworth, NEW MEXICO FEATHERGRASS, New Mexico n.	NPW			7	8 9 10
<i>HETEROPOGON</i> Pers., Tanglehead					
<i>H. contortus</i> (L.) P. Beauv. ex Roem. & Schult., TANGLEHEAD, retorcido moreno, barba negra	NPW	2		6	7 10



*LAMARCKIA* Moench*L. aurea* (L.) Moench, GOLDENTOP IAC*LEERSIA* Sw., Cutgrass

<i>L. hexandra</i> Sw., CLUBHEAD C	NPW	2	6						
<i>L. lenticularis</i> Michx., CATCHFLYGRASS	NPW	1	2						
<i>L. monandra</i> Sw., BUNCH C.	NPW	2	6						
<i>L. oryzoides</i> (L.) Sw., RICE C.	NPW	1	2	3	4	5	6	7	8 10
<i>L. virginica</i> Willd., WHITEGRASS, Virginia c.	NPW	1	2	3	4				

*LEPTOCHLOA* P. Beauv., Sprangletop

<i>L. chloridiformis</i> (Hack.) Parodi, ARGENTINE S	NPW	2							
<i>L. dubia</i> (Kunth) Nees, GREEN S., Texas crowfoot	NPW	2	4	5	6	7	8	9	10
<i>L. fascicularis</i> (= <i>L. fusca</i> subsp. <i>fascicularis</i> )									
<i>L. filiformis</i> (= <i>L. panicea</i> subsp. <i>mucronata</i> )									
<i>L. fusca</i> (L.) Kunth									
subsp. <i>fascicularis</i> (Lam.) N. Snow, BEARDED S	NAW	1	2	3	4	5	6	7	8 9 10
subsp. <i>uninervia</i> (J. Presl) N. Snow, MEXICAN S	NAW	2	3	5	6	7			
<i>L. panicea</i> (Retz.) Ohwi subsp. <i>mucronata</i> (Michx.) Nowack, RED S., slendergrass	NAW	1	2	3	4	5	6	7	8 9 10
<i>L. nealleyi</i> Vasey, NEALLEY S.	NAW	2	6						
<i>L. panicoides</i> (J. Presl) A. Hitchc., AMAZON S	NAW	1	2						
<i>L. scabra</i> Nees, ROUGH S	IAC	2							
<i>L. uninervia</i> (= <i>L. fusca</i> subsp. <i>uninervia</i> )									
<i>L. virgata</i> (L.) P. Beauv., TROPIC S	NPW	2	6	7					
<i>L. viscida</i> (Scribn.) Beal, STICKY S	NAW								10

*LEPTOLOMA* (= *DIGITARIA*)

*L. arenicola* (= *Digitaria arenicola*)

*L. cognatum* var. *arenicola* (= *Digitaria arenicola*)

*L. cognatum* (= *Digitaria cognatum* subsp. *cognatum*)

*LEYMUS* Hochst., Wildrye

<i>L. triticoides</i> (Buckl.) Pilger, CREEPING W., beardless w.	NPC	8	10
			CUL

*LEPTURUS* (= *PARAPHOLIS*)*L. incurvus* (= *Parapholis incurvus*)*LIMNODEA* L. H. Dewey



*MICROSTEGIUM* Nees

*M. vimineum* (Trin.) A. Camas, NEPALESE BROWNTOP IAW 1

*MISCANTHUS* Anderss.

*M. sinensis* Anderss., EULALIA, Silvergrass IPW CUL

*MNESITHEA* Kunth, Jointtail

*M. cylindrica* (Michx.) Koning & Sosef, CAROLINA J. NPW 1 2 3 4 5 6 7 8

*M. granularis* (L.) Koning & Sosef, PITSCALEGRASS IAW

*M. rugosa* (Michx.) Koning & Sosef, WRINKLED J. NPW 1 2

*MONANTHOCHLOA* Engelm

*M. littoralis* Engelm., SHOREGRASS, dwarfstand saltgrass, keygrass NPW 2

*MONERMA (=HAINARDIA)*

*M. cylindrica* (=Hainardia cylindrica)

*MOOROCHLOA (=BRACHIARIA)*

*M. eruciformis* (=Brachiaria eruciformis) Shaw et al. 2011

*MUHLENBERGIA* Schreb., Muhly

*M. andina* (Nutt.) A. Hitchc., FOXTAIL M. NPW 10

*M. arenacea* (Buckl.) A. Hitchc., EAR M., sand m. NPW 7 9 10

*M. arenicola* Buckl., SAND M. NPW 7 8 9 10

*M. asperifolia* (Trin.) Parodi, SCRATCHGRASS, alkali m., rough-leaved dropseed, rough-leaved m. NPW 7 8 9 10

*M. brevis* C. O. Gooding, SHORT M. NAW 10

*M. bushii* R. W. Pohl, NODDING M. NPW 4

*M. capillaris* (Lam.) Trin., HAIRYAWN M., long-awned hairgrass, slender m. NPW 1 2 3

*M. crispiseta* A. Hitchc., MEXICAN M. IAW 10

*M. cuspidata* (Torr.) Rydb., PLAINS M. NPW 9

*M. depauperata* Scribn., SIXWEEKS M. NAW 10

*M. diversiglutinis* Trin. IAW 2

*M. dubia* E. Fourn., PINE M. NPW 10

*M. eludens* C. Reeder, GRAVELBAR M. NAW 10

*M. emersleyi* Vasey, BULLGRASS, bluegrass NPW 7 10

*M. expansa* (Poir.) Trin., CUTOVER M. NPW 1 2

*M. filiformis* (Thurb. ex S. Wats.) Rydb., PULL-UP M. IAW 3

[illegible]





<i>P. anceps</i> Michx., BEAKED P.	NPW	1	2	3	4		7			
<i>P. angustifolium</i> (= <i>Dichantherium aciculare</i> )										
<i>P. antidotale</i> Retz., BLUE P	IPW		2	3	4		6	7	8	9 CUL
<i>P. arizonicum</i> (= <i>Urochloa arizonica</i> )										
<i>P. bergii</i> Arechav	IPW		2	3	4					
<i>P. brachyanthum</i> Steud., PIMPLE P	NPW	1	2	3						
<i>P. brizanthum</i> (= <i>Urochloa brizantha</i> )										
<i>P. bulbosum</i> Kunth, BULB P.	NPW						7			10
<i>P. capillare</i> L., COMMON WITCHGRASS	NAW	1	2	3	4	5		7	8	9 10
<i>P. capillarioides</i> Vasey, SOUTHERN WITCHGRASS, slender panicgrass	NPW		2				6			
<i>P. ciliatissimum</i> (= <i>Urochloa ciliatissima</i> )										
<i>P. clandestinum</i> (= <i>Dichantherium clandestinum</i> )										
<i>P. coloratum</i> L., KLEINGRASS	IPW			3	4	5		7		CUL
<i>P. commutatum</i> (= <i>Dichantherium commutatum</i> )										
<i>P. condensum</i> (= <i>P. rigidulum</i> )										
<i>P. depauperatum</i> (= <i>Dichantherium depauperatum</i> )										
<i>P. dichotomum</i> (= <i>Dichantherium dichotomum</i> var. <i>dichotomum</i> )										
<i>P. dichotomiflorum</i> Michx., FALL P., spreading witchgrass	NAW	1	2	3	4		7		9	
<i>P. diffusum</i> Sw., SPREADING P	NPW		2	3	4	5	6	7	8	10
<i>P. ensifolium</i> (= <i>Dichantherium ensifolium</i> )										
<i>P. fasciculatum</i> (= <i>Urochloa fasciculata</i> )										
<i>P. filipes</i> (= <i>P. hallii</i> var. <i>filipes</i> )										
<i>P. firmulum</i> (= <i>Setaria reverchonii</i> subsp. <i>firmula</i> )										
<i>P. flexile</i> (Gatt.) Scribn. in Kearney, WIRY WITCHGRASS	NAW			3	4					
<i>P. geminatum</i> (= <i>Paspalidium geminatum</i> )										
<i>P. ghiesbreghtii</i> E. Fourn., GHIESBREGHT P	NPW		2				6			
<i>P. gymnocarpon</i> Ell., SAVANNAH P.	NPW	1	2	3						
<i>P. hallii</i> Vasey var. <i>filipes</i> (Scribn.) Waller, FILLY P	NPW		2	3	4	5	6	7	8	10
var. <i>hallii</i> , HALLS P	NPW		2	3	4	5	6	7	8	9 10
<i>P. havardii</i> Vasey, HARVARD P	NPW						7		9	10
<i>P. helleri</i> (= <i>Dichantherium oligosanthes</i> var. <i>scribnerianum</i> )										
<i>P. hemitonum</i> Schult., MAIDENCANE, Simpson's grass	NPW	1	2	3						
<i>P. hians</i> Ell., GAPING P	NPW	1	2	3	4		6	7		
<i>P. hillmanii</i> Chase, HILLMAN P	NAW					5		8	9	10
<i>P. hirsutum</i> Sw., HAIRY WITCHGRASS, giant witchgrass, hairy p.	NPW		2				6			



*sphaerocarpon*

var *sphaerocarpon*)

<i>P. tenerum</i> Bevr. ex Trin.	NPW	1	2
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P. tennesseense (= *Dichanthelium acuminatum*  
var. *acuminatum*)

P texanum (= *Urochloa texana*)

<i>P. trichoides</i> Sw	NAW	2
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<i>P. verrucosum</i> Muhl.	WARTY P.	NAW	1	2	3	7
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P. villosissima (= *Dichanthelium acuminatum* var. *villosum*)

P. virgatum L. SWITCHGRASS		NPW	1	2	3	4	5	6	7	8	9	10
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*P. wernerii* (= *Dichanthelium linearifolium*)

*P. xalapense* (= *Dichanthelium laxiflorum*)

*PAPPOPHORUM* Schreb., Pappusgrass

<i>P. bicolor</i> E Fourn., PINK P., two-colored p.	NPW	2	6	7	8	10
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<i>P. vaginatum</i> Buckl., WHIPLASH P, mucronulate p.	NPW	2	6	7	10
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*P. wrightii* (= *Enneapogon desvauxii*)

*PARAPHOLIS* C. E. Hubb

*P. incurva* (L.) C. E. Hubb., SICKLEGRASS IAC 2

PASCOPYRUM (= *ELYMUS*)

*P. smithii* (= *E. smithii*)

*PASPALIDIUM* Stapf

<i>P. geminatum</i> (Forssk.) Stapf, EGYPTIAN	IPW	1	2	3	5	6
PASPALIDIUM						

*PASPALUM* L., Paspalum

<i>P. acuminatum</i> Raddi, BROOK P	NPW	1	2	3	5	6
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*P. alnum* M. A. Chase, COMBS P. NPW 1 2

<i>P. bifidum</i> (Bertol.) Nash.	PITCHFORK P.	NPW	1	2	3
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*P. boscianum* Flugge, BULL. P. NPW 1 2

P. circulare (= *P. laeve* var. *circulare*)

<i>P. conjugatum</i> P. J. Bergius.	SOUR P.	NPW	2
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<i>P. conspersum</i> Schrad., SCATTERED P.	IPW	2
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*P. convexum* Humb & Bonpl ex Flugge, NPW 1  
MEXICAN P.

<i>P. dilatatum</i> Poir., DALLISGRASS, paspalum grass	IPW	1	2	3	4	5	6	7	8	9	10
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<i>P. dissectum</i> (L.) L., MUDBANK P.	NPW	1	2	3
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<i>P. distichum</i> L., KNOTGRASS, jointgrass, Ft. Thompsongrass	NPW	1	3	4	5	6	7	8	9	10	
<i>P. floridanum</i> Michx., FLORIDA P., big Florida p., big p.,	NPW	1	2	3	4	5	7				
<i>P. fluitans</i> (Ell.) Kunth, WATER P.	NAW	1	2	3							
<i>P. hartwegianum</i> E. Fourn., HARTWEG P.	NPW	2					6	7			
<i>P. hydrophilum</i> (= <i>P. modestum</i> )											
<i>P. intermedium</i> Munro ex Morong & Britt., INTERMEDIATE P.	IPW										
<i>P. laeve</i> Michx., ROUND-SEED P., field p. smooth p.	NPW	1	2	3							
<i>P. laeve</i> var. <u>circulare</u> (= <i>P. laeve</i> )											
<i>P. laeve</i> var. <u>pilosum</u> (= <i>P. laeve</i> )											
<i>P. langei</i> (E. Fourn.) Nash, RUSTYSEED P., Lange's p.	NPW	1	2	3			6				
<i>P. lentiferum</i> (= <i>P. praecox</i> )											
<i>P. lividum</i> Trin. ex Schltal., LONGTOM, pull-and-be-damned	NPW	1	2				6				
<i>P. longipilum</i> (= <i>P. laeve</i> var. <i>pilosum</i> )											
<i>P. malacophyllum</i> Trin., RIBBED P.	IPW				3						
<i>P. minus</i> E. Fourn., MAT P.	NPW	1	2				6				
<i>P. modestum</i> Mez, WATER P.	IPW		2								
<i>P. monostachyum</i> Vasey, GULFDUNE P., single-spike p.	NPW		2				6				
<i>P. notatum</i> Flugge, BAHIA GRASS	IPW	1	2	3	4	5	7				
<i>P. paspalodes</i> (= <i>P. distichum</i> )											
<i>P. plicatulum</i> Michx., BROWNSEED P., plaited p.	NPW	1	2	3	4		6	7			
<i>P. praecox</i> Walt., EARLY P.	NPW	1	2	3							
<i>P. pubiflorum</i> Rupr. ex E. Fourn., HAIRYSEED P., smoothseed p., hairyflowered p.	NPW	1	2	3	4	5	6	7	8	10	
<i>P. pubiflorum</i> var. <u>glabrum</u> (= <i>P. pubiflorum</i> )											
<i>P. repens</i> (= <i>P. fluitans</i> )											
<i>P. scrobiculatum</i> L., INDIA P.	IPW				3						
<i>P. separatum</i> Shinnars	NPW				3						
<i>P. setaceum</i> Michx.											
var. <u>ciliatifolium</u> (Michx.) Vasey, FRINGELEAF P.	NPW	1	2	3							
var. <u>muhlenbergii</u> (Nash) D. Banks	NPW	1	2	3	4	5	7				
var. <u>setaceum</u> , THIN P.	NPW	1					7				
var. <u>stramineum</u> (Nash) D. Banks	NPW	1	2	3	4	5	6	7	8	9	10
<i>P. stramineum</i> (= <i>P. setaceum</i> var. <i>stramineum</i> )											
<i>P. texanum</i> (= <i>P. plicatulum</i> )											
<i>P. unispicatum</i> (Scribn. & Merr.) Nash, ONESPIKE P.	NPW	2					6				
<i>P. urvillei</i> Steud., VASEYGRASS, Urville's p.	IPW	1	2	3	4	5	7				

<i>P. vaginatum</i> Sw., SEASHORE P., sand knotgrass	NPW	2																	
<i>P. virgatum</i> L., TALQUEZAL	NPW																	6	
<i>P. wrightii</i> A. Hitchc., WRIGHT'S P.	IPW	2																	
<i>PENNISETUM</i> Rich., Fountaingrass																			
<i>P. alopecuroides</i> (L.) Spreng., FOXTAIL F.	IPW																		
<i>P. ciliare</i> (L.) Link., BUFFELGRASS	IPW	2	3	4					6	7								CUL	10
<i>P. flaccidum</i> Griseb., HIMALAYAN F.																		CUL	
<i>P. glaucum</i> (L.) R. Br., PEARL MILLET	IAW	2	3															CUL	
<i>P. macrostachys</i> (Brongn.) Trin., PURPLE F.	IAW																	CUL	
<i>P. nervosum</i> (Nees) Trin., BENTSPIKE P.	IPW	2								6								CUL	
<i>P. orientale</i> Willd. ex Rich., LAURISAGRASS	IPW	2	3															CUL	
<i>P. polystachion</i> (L.) Schult., MISSIONGRASS	IAPW																	CUL	
<i>P. purpureum</i> Schumach., NAPIERGRASS, elephantgrass	IPW	2	3															CUL	
<i>P. setaceum</i> (Forssk.) Chiov., F.	IPW	2	3															CUL	
<i>P. setigerum</i> (Vahl) Wipff, BIRDWOODGRASS	IPW									6	7							CUL	
<i>P. villosum</i> R. Br. ex Fresen., FEATHERTOP	IPW		3								7							CUL	10
<i>PHALARIS</i> L., Canarygrass																			
<i>P. angusta</i> Nees ex Trin., TIMOTHY C.	NAC	1	2	3						6	7							10	
<i>P. aquatica</i> L., HARDINGGRASS	IPC										7							10	
<i>P. arundinacea</i> L., REED C.	NPC											8							
<i>P. brachystachys</i> Link., SHORTSPIKE C.	IAC											6							
<i>P. canariensis</i> L., C.	IAC	1	2	3							7								
<i>P. caroliniana</i> Walt., CAROLINA C., southern c.	NAC	1	2	3	4	5	6	7	8	9	10								
<i>P. minor</i> Retz., LITTLESEED C.	IAC		2																
<i>P. stenoptera</i> (= <i>P. aquatica</i> )																			
<i>PHLEUM</i> L.																			
<i>P. pratense</i> L., TIMOTHY	IPC	1		3															
																		CUL	
<i>PHRAGMITES</i> Adans.																			
<i>P. australis</i> (Cav.) Trin. ex Steud., COMMON REED	NPW	1	2	3	4	5	6	7	8	9	10								

*P. communis* (= *P. australis*)

*PHYLLOSTACHYS* Sieb. & Zucc.

<i>P. aurea</i> A & C Riv , GOLDEN BAMBOO	IPC	3	7	CUL
<i>P. aurosulcata</i> , NOT VERIFIED	IPC			CUL
<i>P. nigra</i> , NOT VERIFIED	IPC			CUL

## PIPTANTHERA (=ORYZOPSIS)

*P. micranthum* (= *Oryzopsis micrantha*)

*PIPTOCHAETIUM* J. Presl, Needlegrass

<i>P. avenaceum</i> (L.) Parodi. BLACKSEED N, black oatgrass, oats n.	NPC	1	2	3
<i>P. fimbriatum</i> (Kunth) A. Hitchc., PINYON RICEGRASS	NPW			10
<i>P. pringlei</i> (Scribn.) Parodi. PRINGLE N.	NPW			10

PLEURAPHIS (=HILARIA)

*P. jamesii* (= *Hilaria jamesii*)  
*P. muticus* (= *Hilaria muticus*)

*POA* L., Bluegrass

<i>P. annua</i> L., ANNUAL B., low speargrass, dwarf meadowgrass	IAC	1	2	3	4	5	6	7	8	9	10
<i>P. arachnifera</i> Torr., TEXAS B.	NPC	1	2	3	4	5		7	8		
<i>P. arida</i> Vasey, PLAINS B.	NPC									9	
<i>P. autumnalis</i> Muhl. ex Ell., AUTUMN B., flexuous speargrass	NPC	1	2	3							
<i>P. bigelovii</i> (Vasey) Scribn., BIGELOW B.	NAC							7	8	9	10
<i>P. bulbosa</i> L., BULBOUS B.	IPC					5					
<i>P. chapmaniana</i> Scribn., CHAPMANN B.	NAC	1			4	5					
<i>P. compressa</i> L., CANADA B.	IPC					5	6		9	10	
<i>P. fendleriana</i> (Steud.) Vasey, MUTTONGRASS, mutton b., fendler b.	NPC									10	
<i>P. interior</i> Rydb., INLAND B.	NPC										10
<i>P. occidentalis</i> Vasey, NEW MEXICAN B.	NPC										10
<i>P. pratensis</i> L., KENTUCKY B., junegrass	N/IPC	1				5			9	10	
<i>P. strictiramea</i> A. Hitchc., CHISOS B.	NPC										10
<i>P. sylvestris</i> Gray, WOODLAND B., Sylvan speargrass	NPC	1									
<i>P. trivialis</i> L., ROUGH B.	IPC						6				CUL

*POLYPOGON* Desf., Polypogon, Beardgrass

*P. elongatus* Kunth, SOUTHERN B. NPC 10

*P. interruptus* H B K., DITCH B. IPC 7

*P. monspeliensis* (L.) Desf., RABBITFOOT P., annual beardgrass, rabbitfoot-grass IAC 1 2 3 4 5 6 7 8 9 10

*P. semiverticillatus* (= *P. viridis*)

*P. viridis* (A. Gouan) M. Breistroffer, WATER BENTGRASS IPC 4 5 6 7 8 10

*PSATHYSTACHYS* Nevski, Wildrye

*P. juncea* (Fischer) Nevski, RUSSIAN W. IPC 10 CUL

PSEUDOROEGRERIA (= *ELYMUS*)

*P. arizonica* (= *Elymus arizoncus*)

*P. spicata* (= *Elymus spicatus*)

*PUCCINELLIA* Parl., Alkaligrass

*P. fasciculata* (Torr.) E. Bickn., SALT MARSH A. IPC 8

*REDFIELDIA* Vasey

*R. flexuosa* (Thurb. ex A. Gray) Vasey, BLOWOUT GRASS NPW 9

RHYNCHELYTRUM (= *MELINIS*)

*R. repens* (= *Melinis repens*)

*ROSTRARIA* Trin.

*R. cristata* (L.) Tzvelev, ANNUAL JUNEGRASS IAC 2 3

*ROTTBOELLIA* L. f.

*R. cochinchinensis* (Lour.) W. Clayton, ITCHGRASS IAW 2

*SACCHARUM* L., Plumegrass

*S. alopecuroides* (L.) Nutt., SILVER P. NPW 1 2

*S. baldwinii* Spreng., NARROW P. NPW 1 2

*S. bengalense* Retz., TALL P. IPW

CUL

*S. brevibarbe* (Michx.) Pers.

var. *brevibarbe*, SHORT BEARD P. NPW 1 2

var. *contortum* (Ell.) R. D. Webster, BENTAWN P. NPW 1 2 3





## SCLEROPOA (=DESMAZERIA)

S. rigida (=D. rigida)

## SCLEROPOGON Philippi

*S. brevifolius* Philippi, BURROGRASS NPW 8 9 10

## SECALE L., Rye

*S. cereale* L., RYE IAC 2 3 4 5 7 8 9 10  
CUL

## SETARIA P. Beauv., Bristlegrass, Millet

*S. adhaerans* (Forsk.) Chiov., TROPICAL BARBED B. IAC 2 3*S. corrugata* (Ell.) Schult., COASTAL B. NPW 1 2*S. firmula* (= *S. reverchonii* subsp. *firmula*)*S. geniculata* (= *S. parviflora*)*S. glauca* (= *S. pumila*)*S. griesbachii* E. Fourn., GRIESBACH B. NAW 6 7 10*S. italica* (L.) P. Beauv., FOXTAIL M., Italian m. IAW 4 7 8  
CUL*S. leucopila* (Scribn. & Merr.) K. Schum., PLAINS B. NPW 2 5 6 7 8 9 10*S. lutescens* (= *S. pumila*)*S. macrostachya* Kunth, PLAINS B. NPW 2 6 7*S. magna* Griseb., GIANT B., giant foxtail grass NAW 2*S. palmifolia* (J. König) Stapf, PALMGRASS IPW 2*S. parviflora* (Poir.) Kerguel., KNOTROOT B. NPW 1 2 3 4 5 6 7 8 9 10  
CUL*S. pumila* (Poir.) Roem. & Schult., YELLOW B. IAW 1 2 3 4 5 7 8 9 10*S. reverchonii* (Vasey) Pilgersubsp. *firmula* (A. Hitchc. & Chase) W. E. Fox, KNOTGRASS NPW 2 6subsp. *ramiseta* (Scribn.) W. E. Fox, RIO GRAND BRISTLEGRASS NPW 2 5 6 7 8subsp. *reverchonii*, REVERCHON B. NPW 2 3 5 6 7 8 9 10*S. scheelei* (Steud.) A. Hitchc., SOUTHWESTERN B., Scheele's b. NPW 2 4 6 7 8 9 10*S. texana* Emery, TEXAS B. NPW 6 7 10*S. verticillata* (L.) P. Beauv., HOOKED B., bur b., foxtail grass IAW 3 4 5 6 7 10*S. villosissima* (Scribn. & Merr.) K. Schum., HAIRYLEAF B. NPW 6 7 10*S. viridis* (L.) P. Beauv., GREEN B., green foxtail grass IAW 4 5 6 7 8 9 10

## SITANION (=ELYMUS)

S. hystrix (=E. longifolius)

## SORGHASTRUM Nash, Indiangrass

S. avenaceum (=S. nutans)

S. elliptii (C. Mohr) Nash, SLENDER I., long-bristled I. NPW 1 2 3 4 5 6 7 8 9 10

S. nutans (L.) Nash, YELLOW I., indianreed NPW 1 2 3 4 5 6 7 8 9 10

## SORGHUM Moench, Sorghum

S. bicolor (L.) Moench, GRAIN S. IAW 2 3 4 6 7 CUL 10 CUL

S. x drummondii (Steud.) Mills &amp; M. A. Chase, SUDANSGRASS IAW 3 4 5 7 8

S. halepense (L.) Pers., JOHNSONGRASS IPW 1 2 3 4 5 6 7 8 9 10

S. sudanense (=S. x drummondii)

S. vulgare (=S. bicolor)

## SPARTINA Schreb., Cordgrass

S. alterniflora Loisel. var. glabra (Muhl.) Fern., SMOOTH C., salt-marshgrass NPW 2

S. bakeri Merr., SAND C. NPW 2

S. cynosuroides (L.) Roth., BIG C., salt-reedgrass NPW 2

S. juncea (=S. patens)

S. densiflora Brongn., DENSEFLOWERED C. IPW 7

S. patens (Ait.) Muhl., MARSHHAY C., rush saltgrass NPW 2

S. pectinata Link., PRAIRIE C., tall marshgrass, sloughgrass NPW 2 4 5 7 8 9

S. spartinae (Trin.) Merr. ex A. Hitchc., GULF C., coastal sacahuista, sacahuista NPW 2 3 6 7

## SPHENOPHOLIS Scribn., Wedgescale

S. filiformis (Chapm.) Scribn., LONGLEAF W. NPC 1

S. intermedia (=S. obtusa var. major)

S. interrupta (Buckl.) Scribn., PRAIRIE W. IAC 1 2 3 4 5 7 8 9 10

S. longiflora (Vasey ex L. H. Dewey) A. Hitchc., BAYOU W. NAC 1 2 3

S. nitida (Biehl.) Scribn., SHINY W. NPW 1 7

S. obtusata (Michx.) Scribn., PRAIRIE W. NAC 1 2 3 4 5 7 8 9 10

## SPOROBOLUS R. Br., Dropseed

S. airoides (Torr.) Torr., ALKALI SACATON NPW 2 6 7 8 9 10

S. airoides var. wrightii (=S. wrightii)



<i>S. texanus</i> Vasey, TEXAS D.	NPW							8	9	10
<i>S. tharpii</i> A. Hitchc., PADRE ISLAND D.	NPW	2					6			
<i>S. vaginiflorus</i> (Torr. ex A. Gray) Torr. ex A. Wood										
var. <i>ozarkanus</i> (Fern.) Shinnery, OZARK D.	NAW				4	5		7		
var. <i>vaginiflorus</i> , POVERTY D., southern povertygrass	NAW	1		3	4	5	6	7	8	
<i>S. virginicus</i> (L.) Kunth, SEASHORE D., seashore rushgrass	NPW	2								
<i>S. wrightii</i> Munro ex Scribn., BIG SACATON, Wright's sacaton	NPW						6	7		10

## STEINCHISMA (=PANICUM)

*S. hians* (*Panicum hians*)

## STENOTAPHRUM Trin.

<i>S. secundatum</i> (Walt.) O. Ktze., ST. AUGUSTINEGRASS	IPW	1	2	3	4		6	7		CUL
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## STIPA L., Needlegrass

<i>S. arida</i> M. E. Jones, MORMON N., desert n.	NPW									10
<u><i>S. avenacea</i> (= <i>Piptochaetium avenaceum</i>)</u>										
<i>S. clandestina</i> Hack., SHARPLEAF N., mexican n.	IPW						7			
<u><i>S. columbiana</i> (= <i>S. perplexa</i>)</u>										
<u><i>S. comata</i> (= <i>Hesperostipa comata</i>)</u>										
<i>S. curvifolia</i> Swallen, GUADALUPE N.	NPC									10
<i>S. eminens</i> Cav., SOUTHWESTERN N., tall n.	NPC									10
<i>S. hymenoides</i> Roem. & Schult., INDIAN RICEGRASS	NPC								9	10
<u><i>S. leucotricha</i> (= <i>Nassella leucotricha</i>)</u>										
<i>S. lobata</i> Swallen, LITTLEAWN N., lobed n.	NPC								9	10
<u><i>S. nelsonii</i> (= <i>S. perplexa</i>)</u>										
<u><i>S. neomexicana</i> (<i>Hesperostipa neomexicana</i>)</u>										
<i>S. perplexa</i> (P. Hoge & M. Barkworth) Wipff & Jones, COLUMBIA N., alpine n.	NPC						7			10
<u><i>S. pringlei</i> (= <i>Piptochaetium pringlei</i>)</u>										
<i>S. robusta</i> (Vasey) Scribn., SLEEPYGRASS	NPC								9	10
<u><i>S. tenuissima</i> (= <i>Nassella tenuissima</i>)</u>										
<i>S. scribneri</i> Vasey, SCRIBNER'S N.	NPC									10

## THEMEDA Forrk

<i>T. triandra</i> Forrk, RED OATGRASS	IPW						7			CUL
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## THINOPYRUM (=ELYMUS)

T. hispidum (=Elymus hispidus)T. ponticum (=Elymus ponticum)

## TRACHYOPOGON Nees

T. secundus (J Presl) Scribn., CRINKLEAWN NPW 2 6 10T. montufarii of Hitchcock's Manual Of U. S. Grasses, ed I. (=T. secundus)

## TRAGUS Haller, Burgrass

T. berteronianus Schult., SPIKE B., prickleggrass, IAW 2 6 7 10  
goatgrass

## TRICHACNE (=DIGITARIA)

T. californica (=Digitaria californica)T. hitchcockii (=Digitaria hitchcockii)T. insularis (=Digitaria insularis)T. patens (=Digitaria patens)

## TRICHLORIS E. Fourn., ex Benth., Rhodesgrass

T. crinata (Lag.) Parodi, FALSE R., multflowered NPW 7 10  
chlorisT. pluriflora E. Fourn., MULTIFLOWERED NPW 2 6  
FALSE R., four-flowered chloris

## TRICHONEURA Anders.

T. elegans Swallen, SILVEUSGRASS, hairy- NAW 2 6  
nerve grass

## TRIDENS Roem. &amp; Schult., Tridens

T. albescens (Vasey) Woot. & Standl., WHITE T NPW 2 3 4 5 6 7 8 9 10T. ambiguus (Ell.) Schult., PINEBARREN T NPW 1 2T. avenaceus (=Erioneuron avenaceum var. avenaceum)T. buckleyanus (L. H. Dewey) Nash, BUCKLEY NPW 7  
T.T. congestus (L. H. Dewey) Nash, PINK T NPW 2 4T. eragrostoides (Vasey & Scribn.) Nash, NPW 2 6 7 10  
OVEGRASS T.T. flavus (L.) A. Hitchc.var. chapmanii (Small) Shinnars, NPW 1

CHAPMAN T.

var. flavus, PURPLETOP, redtop NPW 1 2 3 4 5 7 8 9T. grandiflora (=Erioneuron avenaceum var. grandiflorum)





## ZEA L, Corn

*Z. mays* L., CORN

IAW      1 2 3 4 5 6 7 8 9 10  
CUL

*Z. perennis* (A. Hitchc.) Reeves & Mangeld,  
TEOSINTE

IPW	2	
		CUL

*ZIZANIA* L., Wildrice

*Z. texana* A. Hitchc., TEXAS W.

NPW 7

*ZIZANIOPSIS* Doell & Aschers.

*Z. miliacea* (Michx.) Doell & Aschers.,  
MARSHMILLET, water millet, giant cutgrass,  
southern wildrice

NPW	1	2	3	4	6	7
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*ZOYSIA* Willd., Zoysiagrass

*Z. japonica* Steud , JAPANESE LAWNGRASS,  
z , Korean lawnggrass

IPW CUL

*Z. matrella* (L.) Merr., MANILAGRASS

IPW CUL

*Z. pacifica* (Goudswaard) M Hotta & Kuroi,  
KOREAN VELVETGRASS, mascarenegra

IPW

ZULOAGAEA (= *Panicum* in part)

*Z. bulbosa* (= *Panicum bulbosum*)



GRASSES OF TEXAS  
GENERIC KEY TO GROUPS OR SELECTED GENERA

1. Culms woody (bamboo), perennial, flowering irregularly (not every year) ..... 2
1. Culms herbaceous, annual (somewhat woody in *Arundo*), flowering yearly or more frequently ..... 3
- 2(1) Primary culms internodes cylindrical, primary culm branches 1, pseudopetioles usually less than 2 mm long ..... *Arundinaria*
2. Primary culms internodes strongly flattened on 1 side (D-shaped), primary culm branches typically 2, pseudopetiole usually 2–3 mm long ..... *Phyllostachys*
- 3(1) Leaf blades less than 1 cm long, leaves in fascicles, spikelets unisexual, inconspicuous in axils of fascicled leaves ..... *Monanthochloë*
3. Leaf blades more than 1 cm long, leaves not in fascicles; spikelets perfect or unisexual, usually conspicuous ..... 4
- 4(3) Second glumes with 5 rows of hooked spines on abaxial surface ..... *Tragus*
4. Second glumes without hooked spines on abaxial surface ..... 5
- 5(4) Spikelets with unisexual florets only, staminate and pistillate spikelets conspicuously different ..... **Group A**
5. Spikelets at least some with one or more perfect florets, if unisexual, then staminate and pistillate spikelets not conspicuously different ..... 6
- 6(5) Florets 1 per spikelet ..... 7
6. Florets 2 or more per spikelet on at least some spikelets ..... 9
- 7(6) Inflorescence a spike or spicate raceme or raceme (*Aristida oligantha*) ..... **Group B**
7. Inflorescence a panicle, some panicles spicate (depauperate specimens may be reduced to a raceme, e.g. some *Bromus* and *Vulpia*) ..... 8
- 8(7) Panicles open, contracted, or with racemose branches, but without spicate primary unilateral branches ..... **Group C**
8. Panicles with spicate primary unilateral branches ..... **Group D**
- 9(6) Reduced florets below perfect florets (both above and below in *Uniola*, *C* *Chasmanthium*, *Phragmites*, and *tenium*) ..... 10
9. Reduced florets above perfect floret or all florets perfect ..... 17
- 10(9) Reduced florets both above and below fertile florets ..... 11
10. Reduced florets below fertile floret, or both florets reduced/staminate ..... 14
- 11(10) Second glumes dorsally awned ..... *Ctenium*
11. Second glumes awnless or rarely mucronate from apex ..... 12
- 12(11) Plants 1–4 m tall, inflorescences plumose ..... *Phragmites*
12. Plants about 1–2.5 m tall, inflorescences not plumose ..... 13
- 13(12) Disarticulation above glumes, plants of inland or woodland sites ..... *Chasmanthium*
13. Disarticulation below glumes, plants of coastal dunes ..... *Uniola*

14(10).	Glumes both absent; spikelets appear to have 1 floret (also see <i>Paspalum malacophyllum</i> )	15
14	Glumes at least one present; spikelets have 2–3 florets	16
15(14).	Plants perennial, native; upper florets less than 6 mm long	<i>Leersia</i>
15	Plants annual, introduced (cultivated); upper florets 7–12 mm long	<i>Oryza</i>
16(14).	Spikelets paired (except at rame or inflorescence or spicate raceme apex where spikelets are in 3's), one sessile or subsessile and perfect, one pedicellate and sterile ( <i>Saccharum</i> both spikelets perfect), upper floret usually membranous or leaf-like, first glume nearly as long as spikelet (Andropogoneae tribe)	Group E
16.	Spikelets not paired or paired; when paired spikelets both perfect, upper floret dissimilar from lower floret or florets; first glume usually reduced or absent (except in <i>Phalaris</i> and some <i>Panicum</i> species) (Paniceae tribe <i>Ehrharta</i> , and <i>Phalaris</i> )	Group F
17(9)	Inflorescence a spike or spicate raceme or raceme	Group G
17.	Inflorescence a panicle (depauperate specimens may be reduced to a raceme)	18
18(17).	Panicles of spicate primary unilateral branches	Group H
18.	Panicles of open, contracted, or rames but without spicate primary unilateral branches	Group I

**Group A**  
(unisexual spikelets only,  
staminate and pistillate spikelets conspicuously different)

1.	Plants dioecious	2
1.	Plants monoecious	7
2(1).	Plants ascending to erect	3
2.	Plants mat-forming, not ascending or erect	6
3(2).	Plant height 1–3 m tall, rhizomes absent	<i>Cortaderia</i>
3.	Plant height 35–60 cm tall, rhizomes present or absent	4
4(3).	Lemmas 5–veined	<i>Poa</i>
4.	Lemmas strongly 3–veined	5
5(4).	Ligules a ciliate membrane 0.5–1.4 mm long, inflorescences a panicle, lemmas awnless	
5	Ligules a minute fringe of hairs, inflorescences a spicate raceme or narrow panicle; Lemmas awnless (staminate spikelet) or with twisted awn (pistillate spikelet)	<i>Allotetris</i>
6(2).	Pistillate and staminate inflorescences similar in appearance; lemmas 3–veined	<i>Scleropogon</i>
6.	Pistillate inflorescences in bur-like clusters and staminate spikelets in clusters on spicate primary unilateral branches; lemmas 3–veined	<i>Eragrostis</i> <i>Buchloë</i>
7(1).	Staminate and pistillate spikelets borne on separate inflorescences	8
7	Staminate and pistillate spikelets borne on the same inflorescence	9
8(7).	Glumes absent, stamens 6	<i>Luziola</i>
8.	Glumes present, stamens 3	<i>Zea</i>

- 9(7) Pistillate spikelets below staminate spikelets on the inflorescence branch, glumes chartaceous ..... 10
9. Pistillate spikelets above staminate spikelets on the inflorescence branch, glume texture leaf like ..... 11
- 10(9) Pistillate spikelets occurring singly in a hard bead-like structures (white to pale blue) (cultivated) ..... *Coix*
- 10 Pistillate spikelets occur in cobs and no singly ..... *Tripsacum*
- 11(9) Staminate spikelets on lower panicle branches; pistillate spikelets on stiffly erect upper branches ..... *Zizania*
11. Staminate spikelets on base of branch, pistillate spikelets at apex of same branch ..... *Zizaniopsis*

**Group B**  
**(1 floret/spikelet; spike or spicate raceme)**

1. Lemmas 3-awned; spikelets more than 15 mm long ..... *Aristida*
1. Lemmas awnless or with 1 awn; spikelets less than 15 mm long ..... 2
- 2(1) Spikelets in capitate clusters, usually within the leafy part of plant; spikelets unisexual ..... *Buchloe*
2. Spikelets elevated above leaves in elongated inflorescences not in capitate clusters, spikelets with at least 1 perfect floret ..... 3
- 3(2) Inflorescences with spikelets unilateral (on one side) on rachis ..... *Microchloa*
3. Inflorescences with spikelets bilateral on rachis ..... 4
- 4(3) Spikelets solitary, 1 per inflorescence node ..... 5
4. Spikelets 3 per inflorescence node ..... 7
- 5(4) Plants rhizomatous, perennial; inflorescence a raceme ..... *Zoysia*
5. Plants caespitose, annual; inflorescence a spike ..... 6
- 6(5) First glumes present ..... *Parapholis*
6. First glumes absent ..... *Hainardia*
- 7(4) Glumes reduced to awns; inflorescence a spicate raceme (except *Hordeum vulgare* a spike) ..... *Hordeum*
7. Glumes not reduced to awns but rather obvious bracts, inflorescence a spike ..... *Hilaria*

**Group C**  
**(1 floret/spikelet;**  
**panicles without spicate primary unilateral branches)**

1. Panicle spike-like, lemmas 3-veined ..... *Hilaria*
1. Panicles open or contracted but not appearing as a spike; lemmas 3- or 5-veined ..... 2
- 2(1) Spikelets dimorphic (fertile spikelets mixed with and usually concealed by sterile spikelets, lemma 5-veined, veins obscure) ..... *Cynosurus*
2. Spikelets of similar morphology, lemmas 3 or 5 veined, veins distinct or obscure ..... 3
- 3(2) Lemmas 3-veined ..... 4
3. Lemmas not conspicuously 3-veined, either 1- or 5- or more veined or veins inconspicuous ..... 10

- 4(3) Lemma awn branched to 3-awns, sometimes the lateral awns greatly reduced (e.g. 1 mm long) ..... *Aristida*
4. Lemma awn unbranched or lemma awnless ..... 5
- 5(4) Glumes both as long or longer than lemma (excluding awns) ..... 6
5. Glumes, at least the first, shorter than lemma ..... 7
- 6(5) Lemmas awnless or awned from back, base, or cleft apex, glumes exceeding length of lemma ..... *Agrostis*
6. Lemmas awnless or awned from entire apex, glumes nearly equal to lemma length ..... *Muhlenbergia*
- 7(5) Spikelet disarticulation below the glumes, rachilla extending above floret as a minute bristle ..... *Cinna*
7. Spikelet disarticulation above the glumes, rachilla not extended above the perfect floret ..... 8
- 8(7) First glumes with 2 awns, glume veins 2 (even-numbered) ..... *Lycurus*
8. First glumes awnless or with 1 awn, glume veins odd-numbered ..... 9
- 9(8) Veins of lemmas densely pubescent, lemmas awnless ..... *Blepharoneuron*
9. Veins of lemmas glabrous to scabrous, lemmas awned or awnless ..... *Muhlenbergia*
- 10(3) Lemmas indurate and completely enclosing palea for most of its length ..... 11
10. Lemmas coriaceous, membranous or leaf-like, but not obviously indurate, usually not enclosing the palea for entire length ..... 15
- 11(10) Paleas longer than lemmas, grooved longitudinally, lemma margins involute ..... *Piptochaetium*
11. Paleas shorter than or equal to lemmas, flat, lemma margins flat ..... 12
- 12(11) Lemma margins greatly overlapping, paleas less than one-third lemma length ..... *Nassella*
12. Lemma margins not or slightly overlapping, paleas one-third or more lemma length ..... 13
- 13(12) Palea apex flat, usually pubescent, shorter or equal to lemma length, veins usually terminate below palea apex ..... *Stipa*
13. Palea apex keeled, usually glabrous, as long as lemma, veins terminating at palea apex ..... 14
- 14(13) Lemmas more than 7.5 mm long, callus sharp ..... *Hesperostipa*
14. Lemmas less than 7.5 mm long, callus blunt ..... *Oryzopsis*
- 15(10) Glumes absent ..... *Leersia*
15. Glumes present, at least the second ..... 16
- 16(15) Glumes, at least the first, shorter than floret ..... 17
16. Glumes both longer than or equal to floret ..... 21
- 17(16) Lemmas 5-veined, plants of wet habitats or mesic habitats ..... 18
17. Lemmas 1-veined, plants of mesic or xeric habitats ..... 20
- 18(17) Rachilla terminating at upper floret, not becoming a bristle, plants of wet area ..... *Oryza*
18. Rachilla extending above perfect (usually upper) floret into a bristle, plants of mesic areas ..... 19

19(18).	First glumes 0.1 – 1.1 mm long, plants perennial, lemmas acute	<i>Brachelytrium</i>
19	First glumes 1.4–2.6 mm long, plant annual, lemmas bidentate	<i>Apera</i>
20(17).	Lemmas with a tuft of hair at base	<i>Calamovilfa</i>
20	Lemmas without a tuft of hair at base	<i>Sporobolus</i>
21(16).	Glumes and lemmas awnless	22
21	Glumes or lemmas awned	24
22(21).	Lemmas 1-veined, ligules a dense ring of hairs or ciliate membrane	<i>Sporobolus</i>
22	Lemmas 5-veined or veins inconspicuous, ligules membranous	23
23(22).	Panicle branches in verticels of dense whorls, panicles contracted	<i>Polypogon</i>
23	Panicle branches in verticels or not in verticels but not dense, panicles open or contracted	<i>Agrostis</i>
24(21).	Glumes awned	25
24	Glumes awnless (awn-tipped in <i>Gastridium</i> )	26
25(24).	Disarticulation above the glumes, glumes generally 3-veined	<i>Phleum</i>
25	Disarticulation below the glumes; glumes 1-veined	<i>Polypogon</i>
26(24).	Disarticulation of spikelet above glumes	27
26	Disarticulation of spikelet below glumes	28
27(26).	Second glumes 4–5 times longer than lemma	<i>Gastridium</i>
27	Second glumes shorter to longer than lemma but not more than twice as long	<i>Agrostis</i>
28(26).	Lemmas awned from below middle; inflorescence a tightly contracted cylindrical panicle	<i>Alopecurus</i>
28	Lemmas awned from near apex, inflorescence contracted but not tightly cylindrical	<i>Limnorea</i>

**Group D**  
**(1 floret/spikelet;**  
**panicle with spicate primary unilateral branches)**

1.	Panicle branches digitate, sub-digitate or rarely verticillate	<i>Cynodon</i>
1.	Panicle branches generally alternate but definitely not digitate	2
2(1).	Spikelets borne on central axis of inflorescence as well as the branches	<i>Schedonnardus</i>
2.	Spikelets not borne on central axis of inflorescence, occurring only on the branches	3
3(2).	Lemmas 5-veined, paleas 3-veined	<i>Leersia</i>
3.	Lemmas conspicuously 1–3-veined; paleas 2-veined	4
4(3).	Plants 50 cm or more in height, larger spikelets 6–25 mm long	<i>Spartina</i>
4.	Plants 49 cm or less tall; larger spikelets 4–5 mm long	<i>Willkommia</i>

**Group E**  
**ANDROPOGONEAE TRIBE**  
**(2 florets/spikelet; spikelets paired, some pedicels**  
**without spikelets; reduced floret below perfect floret)**

1	Inflorescence a spike raceme, several to many per culm .....	2
1	Inflorescence a panicle of rames (rarely a panicle with a single branch) .....	11
2(1)	Upper lemmas awned .....	3
2	Upper lemmas awnless .....	6
3(2)	Lemma awn less than 3 cm long .....	<i>Schizachyrium</i>
3	Lemma awn more than 3.5 cm long .....	4
4(3)	Inflorescences more than 9 cm long (excluding awns) .....	<i>Trachypogon</i>
4	Inflorescences less than 8 cm long (excluding awns) .....	5
5(4)	Spike racemes composed of many spikelet pairs, inflorescences elongated not fan Shaped .....	
5	Spike racemes composed of a single spikelet (rarely more) and 2 pedicellate spikelets, inflorescences appear fan shaped .....	<i>Heteropogon</i> <i>Themeda</i>
6(2)	Inflorescences pubescent .....	<i>Elionurus</i>
6	Inflorescences glabrous to scabrous .....	7
7(6)	Basal leaf sheaths with stiff, sharp, papilla-based hairs to 3 mm long that irritate the skin, plants annual .....	<i>Rottboellia</i>
7	Basal leaf sheaths glabrous or with a tuft of pilose hair at apex, plants perennial or annual .....	8
8(7)	Sessile spikelets not sunken into thickened rachis, rachis slender .....	9
8	Sessile spikelets sunken into thickened rachis .....	10
9(8)	Plants annual, culms much branched .....	<i>Microstegium</i>
9	Plants perennial, culms not branching above base .....	<i>Eremochloa</i>
10(8)	First glume of sessile spikelets smooth on back, inflorescence axis flattened .....	<i>Hemarthria</i>
10	First glume of sessile spikelets with pits or ridges, inflorescence axis cylindrical or angled but not flattened .....	<i>Mnesithea</i>
11(1)	Rame reduces to a triad of spikelets, lemma awn 10 cm or more long .....	<i>Chrysopogon</i>
11	Rame not a triad of spikelets, lemma awn less than 5 cm long or awnless .....	12
12(11)	Leaf blades with cordate clasping base, plants annual .....	<i>Arthraxon</i>
12	Leaf blades without cordate clasping base, plants perennial or annual .....	13
13(12)	Spikelets, both sessile and pedicellate fertile .....	14
13	Spikelets not both fertile, sessile spikelet fertile and pedicellate sterile or pedicellate spikelet absent .....	17
14(13)	Panicles subdigitate, central axis short, branches seldom rebranch, plants less than 0.5 m tall .....	
14	Panicles with elongated central axis, branches may rebranch several times, plants more than 1 m tall .....	<i>Microstegium</i> 15
15(14)	Spikelets falling in pairs (sessile and pedicellate with inflorescence branch) .....	<i>Saccharum</i>
15	Spikelets falling separate from the inflorescence branch .....	16

- 16(15). Inflorescences greater than 7 cm long; sheath margins connate, spikelets mostly awned ..... *Miscanthus*
- 16 Inflorescence less than 6.9 cm long, sheath margins open, spikelets awnless ..... *Imperata*
- 17(15) Panicles of 2 to 7 paired or digitate or subdigitate rames, a spathe subtending inflorescence bases can be present or absent, pedicels of upper spikelets without central groove or membranous area ..... 18
- 17 Panicles of more than 7 rames (occasionally reduced to 3 branches in *Bothriochloa ischaemum*), spathe not subtending inflorescences, pedicels of upper spikelet with or without a central or membranous area ..... 20
- 18 (17). Sessile spikelet at base of rames staminate and awnless ..... *Hyparrhenia*
- 18 Sessile spikelets at base of rames bisexual and awned ..... 19
- 19(17). Pedicellate spikelets about as large as sessile spikelets, apex broadly rounded, species introduced ..... *Dichanthium*
- 19 Pedicellate spikelets shorter and narrower than sessile spikelets or apex narrow and tapering or absent, species native ..... *Andropogon*
- 20(17). Glume margins setose, the hairs almost appear like spines ..... *Chrysopogon*
- 20 Glume margins not setose, any hairs not appearing like spines ..... 21
- 21(20). Pedicels and usually upper branch internodes on the upper part of inflorescence with a central groove or membranous area ..... *Bothriochloa*
- 21 Pedicels and upper branch internodes on the upper part of inflorescence without a central groove or membranous area ..... 22
- 22(21). Pedicellate spikelets absent, only hairy pedicel remaining ..... *Sorghastrum*
- 22 Pedicellate spikelets present ..... *Sorghum*

## Group F

## ANTHOXANTHUM, EHRHARTA, PHALARIS and PANICEAE TRIBE

[2 or 3 florets/spikelet; reduced floret or florets below perfect floret; panicle inflorescences  
(some spicate racemes or racemes)]

- 1 Ear-like appendages at the margins of second lemma; disarticulation above the glumes ..... *Ehrharta*
- 1 Ear-like appendages absent from the base of the second lemma; disarticulation above or below the glumes ..... 2
- 2(1) Glumes equal, 1 mm or more longer than fertile floret; 2 (occasionally 1) scale-like rudimentary florets below fertile floret, disarticulation above glumes, upper floret coriaceous ..... *Phalaris*
- 2 Glumes unequal (rarely equal, e.g. *Panicum obtusum*) or only second glume present (in some species of *Axonopus*, *Digitaria* and *Paspalum*); if equal then reduced floret as long as spikelet, disarticulation below or above the glumes, upper floret usually firm to indurate (except in *Pennisetum* and *Cenchrus*) ..... 3
- 3(2) Florets 3 per spikelet, disarticulation above glumes, fertile floret with dorsal awn ..... *Anthoxanthum*
- 3 Florets 2 per spikelet, disarticulation below glumes ..... 4

4(3)	Inflorescence a spike or spicate raceme or raceme; spikelets embedded or not embedded in inflorescence	5
4.	Inflorescence a panicle, spikelets not embedded into cavities of inflorescence branches	6
5(4)	Spikelets appear embedded in cavities of rachis	<i>Stenotaphrum</i>
5.	Spikelets not appearing embedded in rachis	<i>Paspalum</i>
6(4)	Panicles of spicate (or racemose) primary unilateral branches	7
6.	Panicles open or contracted but not having spicate primary unilateral branches	20
7(6)	First glumes absent or reduced to a cup-like structure on all or some spikelets	8
7.	First glumes present on all spikelets	12
8(7)	Spikelets subtended by a cup-like or disk-like ring, upper lemma mucronate	<i>Eriochloa</i>
8.	Spikelets not subtended by a cup-like or disk-like ring, upper lemma awnless	9
9(8)	Apex of upper lemma margins folded over palea, not clasping, appearing thin	<i>Digitaria</i>
9.	Apex of upper lemma margins clasping the palea, appearing thick	10
10(9)	Lemma of the fertile florets with rounded surface facing away from inflorescence branch axis	<i>Axonopus</i>
10	Lemma of fertile florets with rounded surface facing inflorescence branch axis	11
11(9)	Lemma of lower florets awned, upper florets mucronate	<i>Echinochloa</i>
11	Lemma of lower florets awnless, upper florets rounded to obtuse to acute, not mucronate	<i>Paspalum</i>
12(7)	Ligules absent; plants annual	<i>Echinochloa</i>
12.	Ligules present, plants annual and perennial	13
13(12)	Glumes both awned	14
13.	Glumes both awnless	16
14(13)	First glumes rudimentary, lower lemmas and second glumes silky villous	<i>Melinis</i>
14.	First glumes well-developed, lower lemmas and second glumes glabrous or pubescent, but both not silky villous	15
15(14)	Awn of first glumes mucronate or shorter than glume body, plants not stoloniferous	<i>Echinochloa</i>
15.	Awn of first glumes 6 mm or more long, plants stoloniferous	<i>Optimemus</i>
16(13)	Upper lemma margins folded over palea, not clasping, appearing thin	<i>Digitaria</i>
16.	Upper lemma margins clasping palea, appearing thick	17
17(16)	First glumes adjacent to primary branch axis, upper lemmas smooth	<i>Brachiaria</i>
17.	First glumes away from primary branch axis, upper lemmas smooth or rugose	18
18(17)	Primary branch extending beyond spikelet as a point or bristle	<i>Paspalidium</i>
18.	Primary branch not extending beyond spikelet as a point or bristle	19
19(18)	Panicle branches appressed, upper lemmas smooth	<i>Panicum</i>
19.	Panicle branches ascending to divergent, upper lemmas rugose	<i>Urochloa</i>
20(6)	First glumes reduced to a cup-like structure subtending spikelet	<i>Eriochloa</i>
20.	First glumes bractlike, not reduced to a cup-like structure (minute in <i>Melinis</i> )	21



21(20).	Spikelets subtended by 1 to many bristles or flattened spines, bristles or spines forming an involucre, or not fused .....	22
21.	Spikelets not subtended by bristles or flattened spines, bristles or flattened spines not present .....	24
22(21).	Spikelets disarticulate above bristles or spines; bristles persistent on inflorescence (see <i>Pennisetum glaucum</i> ) .....	<i>Setaria</i>
22.	Spikelets disarticulate with the bristles or spines, bristles not persistent on inflorescence .....	23
23(22).	Bristles antrorsely barbed .....	<i>Pennisetum</i>
23.	Bristles or spines retrorsely barbed .....	<i>Cenchrus</i>
24(21).	Upper lemma margins folded over palea margins, relatively thin and flexible .....	25
24.	Upper lemma margins inrolled (appearing to clasp) over palea margins, relatively thick and rigid (except immature <i>Panicum brachyanthum</i> ) .....	27
25(24).	Rachilla pronounced between florets, first glume present .....	<i>Melinis</i>
25.	Rachilla not pronounced between florets, first glume absent .....	26
26(25).	Pedicels shorter than spikelet .....	<i>Anthaenantia</i>
26.	Pedicels 2 to several times longer than spikelet .....	<i>Digitaria</i>
27(24).	Second glumes gibbous at base, fertile florets on a short stipe .....	<i>Sacciolepis</i>
27.	Second glumes not gibbous at base, fertile florets without stipe .....	28
28(27).	Ligules absent .....	<i>Echinochloa</i>
28.	Ligules present .....	29
29(28).	Inflorescences of spikelets unbranched primary branches .....	<i>Urochloa</i>
29.	Inflorescences with branches that rebranch .....	30
30(29).	Plants forming a basal rosette of leaves different from cauline leaves; culm simple in cool season with a primary panicle inflorescence per culm, later becoming much branched with small axillary inflorescences in summer and fall .....	<i>Dichanthelium</i>
30.	Plants not forming a basal rosette of leaves; leaves at base similar to cauline leaves; culms with a primary panicle inflorescence in summer and fall (see also <i>Dichanthelium pedicellatum</i> ) .....	31
31(30).	Lemma of perfect florets transversely rugose .....	<i>Urochloa</i>
31.	Lemma of perfect florets smooth or mucronate not transversely rugose .....	<i>Panicum</i>

## Group G

## (2 or more florets/spikelet; spike or spike raceme or racemes)

1	Spikelets in capitate clusters, usually within the leafy part of plant .....	2
1.	Spikelets elevated above leaves, in elongated inflorescences not in capitate clusters .....	4
2(1).	Lemmas 3-awned, awns ciliate .....	<i>Blepharidachne</i>
2.	Lemmas 1-awned, awns not ciliate .....	3
3(2).	Lemmas acuminate, not bifid, florets 2-3, ligules a ring of hairs .....	<i>Munroa</i>
3.	Lemmas bifid, florets 6-12, ligule a ciliate membrane .....	<i>Dasychloa</i>
4(1).	Inflorescences unilateral spikes .....	<i>Bouteloua</i>
4.	Inflorescences bilateral spikes or spike racemes or racemes .....	5

5(4)	Inflorescences a spike with 1 sessile spikelet per node (occasionally 2 spikelets per node in <i>(Elymus smithii)</i> .....	6
5.	Inflorescences a spike with 2 or more sessile spikelets per node (rarely 1 spikelet per node in <i>(Leymus triticoides)</i> or a raceme ( <i>Bromus</i> )....	13
6(5)	Inflorescence a raceme.....	7
6	Inflorescence a spike or spicate raceme.....	8
7(6)	Lemmas bifid, awned from between the lobes of the bifid apex.....	<i>Bromus</i>
7	Lemmas entire, awn terminal.....	<i>Brachypodium</i>
8(7)	First glume absent on all except the terminal spikelet.....	<i>Lolium</i>
8	First glume present on all spikelets.....	9
9(8)	Plants annual; culm bases soft.....	10
9	Plants perennial; culm bases firm.....	11
10(9)	Glumes 1-veined.....	<i>Secale</i>
10	Glumes 5-11-veined.....	<i>Triticum</i>
11(9)	Spikelets spreading from rachis at 40E angle.....	<i>Agropyron</i>
11.	Spikelets appressed to rachis (less than 30 degree angle).....	12
12(11)	Ligules a ciliate membrane; lemmas 3-veined.....	<i>Triopogon</i>
12	Ligules membranous, lemmas 5-several-veined or veins inconspicuous.....	<i>Elymus</i>
13(5)	Spikelets disarticulate in clusters as a complete unit, lemmas 3-veined, veins distinct, stolons or rhizomes present.....	<i>Hilaria</i>
13.	Spikelets disarticulate above or below the glumes but not in clusters, lemmas 5-7-veined, veins indistinct, stolons not present.....	14
14(13)	Disarticulation of spikelets below glumes.....	<i>Psathyrostachys</i>
14	Disarticulation of spikelets above the glumes.....	15
15(14)	Rhizomes present.....	<i>Leymus</i>
15.	Rhizomes absent.....	16
16(15)	Glumes 2-5-veined.....	<i>Elymus</i>
16	Glumes 1-veined.....	<i>Psathyrostachys</i>

**Group H**  
**(2 or more florets/spikelet; inflorescence**  
**a panicle of spicate primary unilateral branches)**

1	Inflorescence a unilateral panicle appearing like a raceme; primary branches short, appearing subsessile to central axis.....	<i>Schlerochloa</i>
1.	Inflorescence with 2 or more spicate primary unilateral branches, primary branches not short and not appearing subsessile to central axis.....	2
2 (1)	Inflorescence branches digitate, subdigitate, or verticillate.....	3
2.	Inflorescence branches alternate or occasionally paired ( <i>Eleusine</i> occasionally reduced to 1-2 branches per inflorescence).....	10
3(2)	Fertile florets 3 or more per spikelet.....	4
3.	Fertile florets 1 or 2 per spikelet.....	6

- 4(3) Inflorescence primary branches terminating in a bare point.....*Dactyloctenium*  
 4 Inflorescence primary branches terminating in a spikelet..... 5
- 5(4) Lemmas 3-awned, panicle branches in verticels, second glumes 1-veined.....*Trichloris*  
 5 Lemmas awnless to mucronate, panicle branches digitate or subdigitate, second glumes 3-7-veined.....*Eleusine*
- 6(3) Leaf blades without a midvein usually conspicuously distichous, second glumes (excluding awn) equal to or longer than spikelet.....*Gymnopogon*  
 6 Leaf blades with midvein, not conspicuously distichous, second glumes (excluding awn) shorter than spikelet..... 7
- 7 (6) Lower lemmas laterally compressed, caryopses triangular or subterete in cross section..... 8  
 7 Lower lemmas dorsally compressed, caryopses dorsally compressed..... 10
- 8(7) Second glume awned.....*Eustachys*  
 8 Second glume awnless..... 9
- 9(8) Lowermost lemma awned.....*Chloris*  
 9 Lowermost lemma awnless.....*Cynodon*
- 10(7) Lowermost lemmas 1-awned.....*Enteropogon*  
 10 Lowermost lemmas 3-awned.....*Trichloris*
- 11(2) Lemmas obscurely 5-veined; plants annual.....*Desmazeria*  
 11 Lemmas conspicuously 3-veined, plants perennial or annual..... 12
- 12(11) Fertile florets 1 per spikelet..... 13  
 12 Fertile florets 2 or more per spikelet..... 14
- 13(12) Spikelets in clusters of 3 per primary branch, upper spikelet with one perfect floret, lower spikelets neuter or staminate.....*Cathastecum*  
 13 Spikelets not in clusters of 3 per primary branch, all spikelets with a perfect floret.....*Bouteloua*
- 14(12) Glumes 8 mm or more long, lemma veins ciliate.....*Trichoneura*  
 14 Glumes less than 7.8 mm long, lemma veins glabrous or puberulent but not with spreading ciliate hairs..... 15
- 15(14) Lemmas glabrous, acute, awnless; spikelets not overlapping on inflorescence Branches.....*Eragrostis*  
 15 Lemmas glabrous or pubescent on veins or near the base, apex acute to obtuse or notched, awned or awnless, when lemmas awnless spikelets overlapping on branches.....*Leptochloa*

**Group I**  
**(2 or more florets/spikelet; reduced floret**  
**at spikelet apex or absent; panicle inflorescence)**

- 1 Plants with unilateral panicles..... 2  
 1 Plants with rebranched panicles or multiple spikelets per primary branch..... 3
- 2(1) Spikelets dimorphic (fertile spikelets mixed with and usually concealed by sterile spikelets), disarticulation below the glumes, glumes 3-9 veined, lemmas 3-veined.....*Sclerochloa*  
 2 Spikelets of similar morphology, disarticulation above the glumes, glumes 1-veined, lemmas 5-veined.....*Cynosurus*

- 3(1) Plants 2 – 6 m tall ..... **4**  
 3 Plants less than 2 m tall ..... **7**
- 4(3) Spikelets 3.5–7 cm long; inflorescences not plumose ..... *Arundinaria*  
 4 Spikelets less than 3.5 cm long; inflorescences a plume-like panicle ..... **5**
- 5(4) Plants without rhizomes (caespitose), glumes 1-veined ..... *Cortaderia*  
 5 Plants rhizomatous, glumes 3- to many-veined ..... **6**
- 6(5) Lemmas densely pubescent, rachilla glabrous ..... *Arundo*  
 6 Lemmas glabrous, rachilla villous ..... *Phragmites*
- 7(3) Lemmas conspicuously 3-veined ..... **8**  
 7 Lemmas 1 or 5- many-veined, or veins obscure (midvein may be conspicuous) ..... **16**
- 8(7) Veins of lemma glabrous or minutely scabrous, lemma base without long hairs ..... **9**  
 8 Veins of lemma pubescent (occasionally puberulent) to long hairy or lemma base with long hairs ..... **11**
- 9(8) Lemma apex with a slight notch, midvein extending into a mucro, panicles contracted ..... *Tridens*  
 9 Lemma apex without a notch, midvein not extending into an awn, panicles open or narrow ..... **10**
- 10(9) Second glumes 1-veined, caryopses not beaked ..... *Eragrostis*  
 10 Second glumes 3-5-veined, caryopses beaked ..... *Diarrhena*
- 11(8) Rhizomes present, well developed ..... *Redfieldia*  
 11 Rhizomes absent ..... **12**
- 12(11) Paleas densely long-ciliate on upper half, plants annual ..... *Triplasis*  
 12 Paleas not densely long-ciliate on upper half, plants annual or perennial ..... **13**
- 13(12) Leaf blades with thick white margins, inflorescences usually less than 4 cm long ..... *Erioneuron*  
 13 Leaf blades without thick white margins, inflorescences longer than 5 cm ..... **14**
- 14(13) Lemmas with 3 awns, these 4 mm long or longer ..... *Triraphis*  
 14 Lemmas awnless or with single awns, if 3 awns then awns mucronate ..... **15**
- 15(14) Inflorescence a panicle of spicate primary branches ..... *Leptochloa*  
 15 Inflorescence a panicle without spicate primary branches ..... *Tridens*
- 16 (7) Lemmas 9- or more awned ..... **17**  
 16 Lemmas 0-3-awned ..... **19**
- 17(16) Glumes 1-veined ..... *Pappophorum*  
 17 Glumes 5- or more-veined ..... **18**
- 18(17) Lowermost lemmas 9-veined, lemma awns 9, subequal, plumose ..... *Enneapogon*  
 18 Lowermost lemmas 11-13-veined, lemma awns 11- 13, unequal, glabrous to scabrous ..... *Cottae*

19(16)	Ligules a line of hairs or ciliate membrane.....	20
19	Ligules membranous for most or all its length.....	23
20(19)	Lemmas 1-veined, apex entire.....	<i>Eragrostis</i>
20	Lemmas strongly 7-9-veined, apex slightly bifid.....	21
21(20)	Caryopsis apex with 2 persistent horn-like style bases, outline orbicular.....	<i>Vaseyochloa</i>
21	Caryopsis apex without persistent horn-like style bases, outline linear to narrowly elliptical.....	22
22(21)	Plants annual, lemmas awnless or nearly so.....	<i>Schismus</i>
22	Plants perennial, lemmas awned.....	<i>Danthonia</i>
23(21)	Glumes or lemmas awned.....	24
23	Glumes and lemmas awnless.....	36
24(23)	Lemmas awned from back with a dorsal attached awn (see also immature <i>Bromus lanceolatus</i> ).....	25
24	Lemmas awned from apex or from between the lobes of bifid apex.....	29
25(24)	Glumes 1.5 cm long or longer.....	<i>Avena</i>
25	Glumes less than 1.5 cm long.....	26
26(25)	Fertile spikelets more than 4 mm long, upper lemmas with a hooked awn.....	<i>Holcus</i>
26	Fertile spikelets less than 2.6 mm long (excluding the awns; upper lemmas without a hooked awn).....	27
27(26)	Spikelets dissimilar, plants with staminate spikelets and fertile spikelets; fertile spikelet lemmas awned from near apex.....	<i>Lamarckia</i>
27	Spikelets all similar, plant without both staminate spikelets and fertile spikelets; fertile spikelet lemmas awned from below the middle.....	28
28(27)	Lemma awn attached dorsally below midlength of the lemma.....	<i>Aira</i>
28	Lemma awn attached dorsally just below the lemma apex.....	<i>Apera</i>
29(24)	Lemmas bifid, awned from between teeth.....	30
29	Lemmas acute, not bifid, awned from apex.....	33
30(29)	Glumes and lemmas papillose or papillose hispid on back.....	<i>Rostraria</i>
30	Glumes and lemmas glabrous to hairy but not papillose or papillose hispid.....	31
31(30)	Paleas adnate to caryopsis, lemma apices usually bifid.....	<i>Bromus</i>
31	Paleas not adnate to caryopsis, lemma apices, entire (or bifid in <i>Sphenopholis interrupta</i> ).....	32
32(31)	Spikelets less than 8 mm long, plants annual; lemma apices entire (bifid in <i>Sphenopholis interrupta</i> ).....	<i>Sphenopholis</i>
32	Spikelets more than 8 mm long, plants annual or perennial; lemma apices bifid.....	<i>Bromus</i>
33(29)	Plants annual, stamen 1 (rarely 3) per floret, leaves less than 2 mm wide, lemmas inconspicuously 5-veined.....	<i>Vulpia</i>
33	Plants perennial, stamen 3 per floret, leaves more than 4 mm wide, lemmas conspicuously 5-veined.....	34

- 34(33). Spikelets strongly compressed, on dense 1-sided panicle branches; leaf sheaths keeled ..... *Dactylis*
34. Spikelets not strongly compressed, not on dense 1-sided panicle branches; leaf sheaths rounded, or not keeled ..... 35
- 35 (34). Basal leaves **with** auricles; blades flat ..... *Schedonorus*
35. Basal leaves **without** auricles; blades flat or involute or conduplicate ..... *Festuca*
- 36(23). Glumes longer than 1.7 cm ..... *Avena*
36. Glumes less than 1.7 cm long ..... 37
- 37(36). Glumes and lemmas spreading at right angles to rachilla, appearing inflated, pedicels slender ..... *Briza*
37. Glumes and lemmas ascending, not close to a right angle to rachilla, not appearing obviously inflated; pedicels various ..... 38
- 38(37). Sheath margins connate at least one-fourth the length ..... 39
38. Sheath margins free for more than three-fourths the length ..... 42
- 39(38). Lemma veins uniformly developed and equally spaced (some prominent, some inconspicuous except at apex) ..... *Glyceria*
39. Lemma veins uniformly developed and not equally spaced (most veins inconspicuous at apex) ..... 40
- 40(39). Spikelets strongly compressed on dense 1-sided panicle branches; leaf sheaths keeled and laterally compressed ..... *Dactylis*
40. Spikelets not strongly compressed on dense 1-sided panicle branches; leaf sheaths terete ..... 41
- 41(40). Paleas usually adnate to caryopsis, lemma usually awned from between the lobes of a bifid apex, some species awnless, caryopsis with tuft of hair at apex ..... *Bromus*
41. Paleas free from caryopsis, lemma awnless (Texas species), apex entire, caryopsis without apical tuft of hair ..... *Metica*
- 42(38). Spikelets dissimilar; plants with staminate spikelets and fertile spikelet, fertile spikelets awned ..... *Lamarckia*
42. Spikelets all similar, plants without both staminate and fertile spikelets, fertile spikelets awnless ..... 43
- 43(42). Paleas colorless throughout ..... 44
43. Paleas yellow, green, or brown, at least on veins ..... 45
- 44(43). Second glumes obovate, widest above the middle, apex obtuse ..... *Sphenopholis*
44. Second glumes lanceolate, widest below the middle, apex acute ..... *Koeleria*
- 45(43). Lemma apex bifid ..... 46
45. Lemma apex acute or obtuse, not bifid ..... 47
- 46(43). Rachilla extended beyond upper floret, panicles narrow, congested ..... *Sphenopholis*
46. Rachilla not extended beyond upper floret, panicles open, diffuse ..... *Aira*
- 47(45). Lemma apex obtuse to broadly acute, lemma veins 5, distinct or indistinct ..... 48
47. Lemma apex attenuate to narrowly acute, lemma veins 5 or more, often indistinct ..... 50

48(47).	Panicles of stiff spicate primary branches; plants annual.....	<i>Desmazeria</i>
48	Panicles of rebranched primary branches, branches not appearing stiff, plants annual or perennial.....	49
49(48)	Lemmas keeled on back (abaxial surface).....	<i>Poa</i>
49.	Lemmas rounded on back (abaxial surface).....	<i>Puccinellia</i>
50(47).	Spikelets with all unisexual florets, ligules a ciliate membrane.....	<i>Distichlis</i>
50	Spikelets with 2 or more perfect florets, ligules membranous.....	51
51(50).	Plants annual, stamen 1 (rarely 3) per floret.....	<i>Vulpia</i>
51.	Plants perennial, stamens 3 per floret.....	52
52(51).	Basal leaves <b>with</b> auricles, blades flat.....	<i>Schedonorus</i>
52	Basal leaves <b>without</b> auricles, blades flat or involute or conduplicate.....	<i>Festuca</i>

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## AN UPDATE OF SALVADORAN ACANTHACEAE

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### ABSTRACT

New distribution records for 18 species of Acanthaceae are reported for departments within El Salvador. One of these, *Justicia calliantha*, is newly reported for the country as well. Forty-four native species in 17 genera are currently known from El Salvador. Regional differences in species richness of Salvadoran Acanthaceae are discussed and mapped.

**KEY WORDS:** Acanthaceae, El Salvador, species richness, *Justicia calliantha*.

Daniel (2001) documented 67 species in 31 genera of Acanthaceae from El Salvador. Forty-three acanthaceous species were treated as native to the country. It was shown that 34 (79%) of the native species had been collected since 1960, and thus, in spite of extensive alteration of biotic communities in that Central American nation, the acanthaceous flora of El Salvador remains relatively rich and intact.

Among the major political divisions (departments) of El Salvador, Daniel (2001) noted an unequal distribution of species. Some departments in the western portion of the country (e.g., Ahuachapán [27] and Santa Ana [25]) had a disproportionately high number of species compared with several departments in north-central El Salvador (e.g., Chalatenango [2], Cuscatlán [1], and Cabañas [1]). Neither sizes of departments nor numbers of biotic communities in them appear to correlate with the numbers of species per department. Daniel (2001) noted possible reasons, including accessibility and thoroughness of collecting activities, for the apparent geographic discrepancies in species richness. Indeed, recent collections from throughout El Salvador that have become available since 2001 reveal the presence of at least 10 and seven species of Acanthaceae in Chalatenango and Cabañas, respectively. It appears that under-collection, at least in these two departments, may account for some of the perceived geographic differences in species richness within the country.

New distribution records for Acanthaceae of El Salvador, which update the distributions reported in Daniel (2001), are noted below by species and department. These include one species, *Justicia calliantha* Leonard, newly reported for the country, and new departmental records for 18 species. Forty-four native species in 17 genera are currently known from the country. Figure 1 shows the political departments of El Salvador and the numbers of native species of Acanthaceae now known for each. Considering the nation's small size, high human population density, and extensive alteration of natural habitats (Williams et al. 2002), the relative richness of Salvadoran Acanthaceae is likely due to the weedy tendencies of many species in the family (cf. Daniel 2004a: 701).



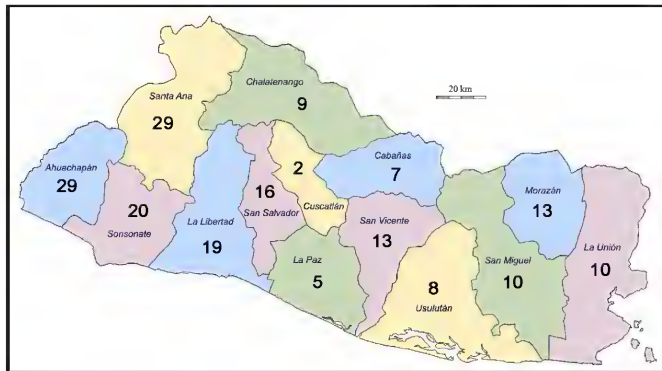


Figure 1. Map of El Salvador showing departments and numbers of native species of Acanthaceae in each.

***Aphelandra heydeana* Donn. Sm.**

**Chalatenango:** San Francisco del Túnel, 1100 m, 23-X-1957, *L. González 1724* (USF).

***Aphelandra scabra* (Vahl) Sm.**

**Chalatenango:** Nuevo Concepción, area protegida Pañanalapa, Los Chorrros, 500 m, 14°05'N, 89°25'W, 18-X-2000 (flr), *K. King & J. Chávez 113* (MO). **Cuscatlán:** a la orilla del Cerrón Grande, 250 m, 13°85'N, 89°2'W, "antorcha," 9-XII-1997 (flr), *M. Renderos 353* (CAS, MO).

***Barleria oenotheroides* Dum. Cours.**

**Cabañas:** Cinquera, Zona Protegida, camino a Río San Benito, 13°53'N, 88°57'W, 374 m, 23-I-2003 (flr), *R. Carballo & F. Medrano 596* (CAS, MO). **Morazán:** A.P. Río Sapo, puente abajo, 636 m, 13°55'N, 88°06'W, 19-I-2005 (flr), *R. Carballo 1243* (MO). **Sonsonate:** Santa Isabel Ishuatán, propiedad de M. Castillo, 13°41'N, 89°33'W, 430 m, bosque de galería, 5-II-2006 (flr), *D. Rodríguez & G. Trejo 201* (MO).

***Elytraria imbricata* (Vahl) Pers.**

**Chalatenango:** El Paraíso, Santa Barbara, 330 m, 14°05'N, 89°05'W, 1-XII-1997 (flr, frt), *J. González & Serrano 479* (CAS, MO)[local name: "coquillo"]; La Palma area, Caballero, 14°18.425'N, 89°08.322'W, 900—1500 m, 8-11-2001, *D. Sloat & D. Reina 322* (U). **Usulután:** Laguna de Alegría, 1070 m, 13°29'N, 88°32'W, 23-I-1999, *D. Williams 65* (MO).

This species was reported from Usulután by Williams et al. (2002), and the specimen cited above from that department confirms their identification.

**Henrya insularis** Nees ex Benth.

**Santa Ana:** Mpio. Metapán, entrada al área protegida San Diego-La Barra (KM 106 carr. Santa Ana-Metapán), 14°16'22"N, 88°27'28"W, 650 m, selva baja caducifolia, 3-I-2004, *J. Linares & C. Martínez 7251* (MEXU). **Usulután:** Laguna de Alegría, 1070 m, 13°29'N, 88°32'W, 18-II-1999, *D. Williams 153* (MO).

This species was reported from Usulután by Williams et al. (2002), and the specimen cited above from that department confirms their identification.

**Hypoestes phyllostachya** Baker

**Ahuachapán:** San Francisco Menéndez, El Corozo, Mariposario, xona alta "Los Peralta," 13°49'N, 89°59'W, 325 m, 23-VIII-2000 (flr), *J. Rosales 1324* (LAGU, MO). **Chalatenango:** La Montañona, CORBELAM, la cadena, 14°23'N, 88°91'W, 1400 m, 18-X-2002 (flr), *R. Cristobal 4677* (MO). **La Unión:** cantón Monteca, Nueva Esparta, alrededores del Cacerío Upire, 13°88'N, 87°86'W, 900 m, 16-XII-2007, *R. Ibarra et al. s.n.* (MO).

This species is native to Madagascar but naturalized in numerous warm-temperate and tropical regions worldwide. In El Salvador it is both cultivated and naturalized. The collection from Ahuachapán noted above was undoubtedly cultivated, but those from Chalatenango and La Unión possibly represent naturalized plants.

**Justicia aurea** Schlecht.

**Chalatenango:** El Paraíso, 330 m, 14°5'N, 89°5'W, 13-VIII-1989 (flr), *J. Gonzalez 526* (CAS) [local name: "antorcha,"].

**Justicia breviflora** (Nees) Rusby

**Cabañas:** Cinquera, ruta El Obrajón—El Tule, 13°53'N, 88°56'W, 560 m, vegetación secundaria en regeneración, 22-VIII-2006 (frt), *J. Monterrosa et al. 1103* (CAS).

These Salvadoran plants have a single flower per node above the proximalmost node.

**Justicia calliantha** Leonard

**Morazán:** A.P. Río Sapo, Cuenca de quebrada seca, 13°55'N, 88°06'W, 689 m, 5-II-2004, *R. Carballo et al. 1029* (MO).

This species is newly reported from El Salvador. It was described and treated by Daniel (2005) as endemic to Honduras, where it is known from the south-central portion of that nation. A related species, *J. sulfurea* (Donn. Sm.) D.N. Gibson, occurs in western El Salvador. These species of *Justicia* sect. *Mesoamericanae* (Daniel 2004b) can be distinguished by the following couplet:

1. Corolla red, 29–34 mm long, externally pubescent with glandular and eglandular trichomes; leaves ovate to broadly ovate to cordate, 1.1–1.9 times longer than wide ..... **Justicia calliantha**
1. Corolla yellow, 17–29 mm long, externally pubescent with eglandular trichomes only; leaves lance-ovate to ovate, 2.5–4.5 times longer than wide ..... **Justicia sulfurea**

**Justicia colorifera** V.A.W. Graham

**Chalatenango:** Nueva Concepción, área protegida Pañanlapa, Los Chorros/Montecillo, 500 m, 14°05'N, 89°25'W, bosque seco, 16-III-2000, *K. King & J. Chávez 9* (MO).

**Justicia comata** (L.) Lam.

**Ahuachapán:** A.P. Santa Rita, sector 3, montaña Santa Rita, 13°48'N, 90°04'W, 20 m, 14-I-2004 (flr), *J. Rosales 1867* (CAS, MO) [local name: "coyuntura"]. **La Libertad:** bed of nearly extinct Laguna de Zapotitan, shore of pool, 9-IX-1951 (flr, frt), *N. Fassett 29349* (WIS).

**Nelsonia canescens** (Lam.) Spreng.

**Cabañas:** Cinquera, Zona Protegida, Campamento el Niño, 13°52'N, 88°58'W, 479 m, 19-II-2003 (flr), *R. Carballo & R. Medrano 624* (CAS).

This species was tentatively treated as native in Central America by Daniel (2001). Although it is similarly treated here, it appears increasingly likely that the Central American, and probably the South American, representatives of *N. canescens* are not native in the New World (cf. Franck & Daniel 2011).

**Ruellia blechum** L.

**Cabañas:** Cinquera, Zona Protegida, camino a Río San Benito, 13°53'N, 88°57'W, 374 m, 23-I-2003 (flr, frt), *R. Carballo & F. Medrano 593* (CAS, MO); Cerro el Ujushte, 450 m, *J. Morales 2110* (USCG). **Chalatenango:** El Paraíso, Santa Barbara, 330 m, 14°5'N, 89°5'W, vegetación secundaria, 1-XII-1997 (flr), *J. González & Serrano 489* (CAS). **San Miguel:** Canton San Antonio Chavez, 30-XII-1978 (flr), *R. Seiler 805* (F). **Santa Ana:** Metapán, P.N. San Diego-La Barra, sector 12, Bosque La Barra, 14°18'N, 89°32'W, 470 m, orillas de veredas en bosque tropical siempre verde, 17-I-2011 (flr, frt), *D. Rodríguez et al. 2232* (CAS). **Usulután:** Laguna de Alegría, 13°29'N, 88°32'W, 1070 m, 23-I-1999 (flr), *D. Williams 19* (LAGU).

This species, treated by Daniel (2001) under the synonym *Blechum pyramidatum* (Lam.) Urb., has been shown to pertain to *Ruellia* (Tripp et al. 2009). The collection from Usulután was noted by Williams et al. (2002), and I confirm the determination based on an image of the specimen at LAGU.

**Ruellia donnell-smithii** Leonard

**Santa Ana:** Santa Ana, *Weedland 406* (C).

**Ruellia geminiflora** Kunth

**Ahuachapán:** San Benito, El Casco, 780 m, 13°49'N, 89°56'W, 20-IX-1997 (flr), *E. Sandoval 1673* (CAS).

**Ruellia inundata** Kunth

**Cabañas:** Cinquera, Zona Protegida, Campamento el Niño, 13°52'N, 88°58'W, 479 m, 19-II-2003 (flr), *R. Carballo & F. Medrano 631* (CAS, MO). **Chalatenango:** Arcatao, Río Zazalapa, 14°06'N, 88°45'W, 360 m, bosque de galería, 20-I-2008 (flr, frt), *R. Ibarra s.n. (JBL 05145)* (MO). **La Paz:** cantón Amulungo, San Pedro Nonualco, 13°36'N, 88°56'W, orilla de la calle, 1-II-1998 (flr, frt), *J. González & M. Hernández 513* (CAS, LAGU, MO). **Morazán:** A.P. Río Sapo, por puente, 13°56'N, 88°06'W, 688 m, 11-III-2004 (flr, frt), *R. Carballo 1135* (MO).

**Ruellia metallica** Leonard

**Santa Ana:** Hacienda "Las Lajas," 1500 m, 23-X-1957 (flr), *A.C. del Cid 1734* (USF).

**Tetramerium tenuissimum** Rose

**Cabañas:** Cinquera, Zona Protegida, cuenca de Río Cutumayo, 13°52'N, 88°58'W, 421 m, 20-III-2003 (flr), *R. Carballo & M. Carrillo 660* (CAS, MO).

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**ANTILLANTHUS DISCOLOR, THE CORRECT NAME FOR ANTILLANTHUS  
ALMIRONCILLO (M. GÓMEZ) B. NORD. (ASTERACEAE: SENECIONEAE)**

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**ABSTRACT**

The name *Antillanthus almironcillo* (M. Gómez) B. Nord. is shown to be illegitimate, and the correct combination *Antillanthus discolor* (Griseb.) J. Girard. is proposed to replace it. A lectotype is also designated for the basionym *Cacalia discolor* Griseb.

**KEY WORDS:** *Antillanthus*, Asteraceae, Caribbean, Compositae, Cuba, lectotypification, nomenclature, Senecioneae.

Collection and entry of data in 2010 for tribe Senecioneae in Wikispecies revealed that the name *Antillanthus almironcillo* (M. Gómez) B. Nord. seemed illegitimate.

The oldest name for *Antillanthus almironcillo* is Grisebach's (1866: 157) *Cacalia discolor*. Replacement names were twice proposed in *Senecio* for *C. discolor*, because the heterotypic *Senecio discolor* (Sw.) DC. [= *Zemisia discolor* (Sw.) B. Nord.] blocked its transfer to that genus. Gómez de la Maza (1890: 277) proposed the name *S. almironcillo*, while Greenman (1912: 323), unaware of Gómez de la Maza's name, coined for it another name, *S. brittonii*. When Nordenstam (2006: 52) moved the species to his new genus *Antillanthus*, he cited in synonymy "*Cacalia discolor* Griseb., non DC." to explain his use of Gómez de la Maza's name as his basionym, seemingly misinterpreting the legitimate *C. discolor* Griseb. as an illegitimate homonym of *Senecio discolor* DC.

Grisebach's protologue included the mention of "*Senecio discolor* Rich. cub. ex descr., non DC." thus directly linking Grisebach's endemic Cuban novelty and the Cuban plants Richard (1850: 66) mistakenly confused with the endemic Jamaican taxon treated subsequently by Nordenstam (2006) as *Zemisia discolor*. It is clear that Grisebach is not citing de Candolle's name as a synonym of his new species. Bibliographic confusion among these two species continued, however, as may be inferred from Jackson (1893) who gave the current taxonomic name of both Cuban *Cacalia discolor* Griseb. (Jackson 1893: 365) and of Jamaican *Cineraria discolor* Sw. (Jackson 1893: 537) as *S. discolor*.

*Cacalia discolor* Griseb. is thus the oldest validly published and legitimate name for the species. The name *Antillanthus almironcillo* is illegitimate under ICBN article 52.1 (McNeil & al. 2006), and a correct combination is provided here.

Grisebach (1866) cited both *Wright 2870* and *Linden 2052*, which Richard (1850) had also cited, in his protologue. *Cacalia discolor* appears not to have been formally typified, although

Greenman (1912) and Nordenstam (2006) cited only *Wright 2870*. Nordenstam (2006) went so far as to cite *Wright 2870* as type (but without a herbarium citation) of *Antillanthus almironcillo*. Because two well-known Senecioneae specialists (Greenman and Nordenstam) based their concepts of this Cuban endemic upon the Wright collection(s), it seems best to formally cite *Wright 2870* in GOET as lectotype.

**ANTILLANTHUS DISCOLOR** (Griseb.) J. Girard, **comb. nov.** Basionym: *Cacalia discolor* Griseb., Cat. Pl. Cub.: 157. 1866. *Senecio almironcillo* M. Gómez, Anales Soc. Esp. Hist. Nat. 19(2): 277. 1890, non *Senecio discolor* (Sw.) DC., Prodr. 6: 412. 1837 [1838]. *Senecio brittonii* Greenm., Publ. Field Mus. Nat. Hist., Bot. Ser. 2(8): 323. 1912, nom. superfl. *Pentacalia almironcillo* (M. Gómez) Proctor, J. Arnold Arbor. 63(3): 312. 1982, non *Pentacalia discolor* (Sw.) H. Rob., J. Arnold Arbor. 63(3): 311. 1982. *Antillanthus almironcillo* (M. Gómez) B. Nord., Compos. Newslett. 44: 52. 2006. **LECTOTYPE:** Cuba. "Cuba occ.", *Wright 2870* (lectotype, **designated here:** GOET, photo MO; presumed isoelectotypes: GH, MO).

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<[http://species.wikimedia.org/w/index.php?title=Antillanthus\\_almironcillo&oldid=1500526](http://species.wikimedia.org/w/index.php?title=Antillanthus_almironcillo&oldid=1500526)>  
Accessed 22 Jun 2012.

## NABALUS ASPERA (ASTERACEAE) IN LOUISIANA

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### ABSTRACT

The occurrence of *Nabalus* (*Prenanthes*) *asper* (Asteraceae) is documented in Louisiana. It was collected by Josiah Hale sometime before 1843, probably in Rapides Parish in some isolated prairie that no longer exists.

**KEY WORDS:** Asteraceae, Compositae, *Nabalus*, *Prenanthes*, Louisiana, Josiah Hale, isolated prairies

In the course of studying the vascular flora of Texas, we occasionally discover information concerning the flora of adjoining states. In this instance, a historic collection of *Nabalus asper* (Michx.) Torrey & A. Gray from Louisiana permits documentation of the species in that state, something, until now, never done. This particular study originated with our discovery, study, and report of the species in Texas, under the name *Prenanthes aspera* Michx. (Singhurst & Holmes 2010).

Following is a short history, with commentary, of *Nabalus asper* in Louisiana.

The initial report of the species in Louisiana was by Torrey and Gray (1843), who proposed the new combination *Nabalus asper*, based upon Michaux's *Prenanthes aspera* (spelling of the epithet varies by gender). In this work, Torrey and Gray used the exclamation point (!) "after the manner in which it is employed by De Candolle and other modern botanists, to indicate that we have seen an authentic specimen of the author, or from the location cited." Thus the distribution was given as this: "Dry barrens and prairies of Ohio! Indiana! Louisiana! and upper Missouri!" No other data was presented.

Riddell, in *Catalogus florae Ludovicianae* (1852), published a list of the vascular flora of Louisiana, the Cyperaceae and Gramineae not included. *Nabalus asper* is included on page 754, but without further comment. The list is based on the results of a great many years of observation by Dr. Josiah Hale, by the late Prof. W.M. Carpenter, and by J.L. Riddell. The work was abridged from a manuscript work, "Plants of Louisiana," submitted to and rejected for publication by the Smithsonian Institution. Reportedly, nearly all of the species are represented by specimens in the author's herbarium [see entry 94 in Ewan (1967) for a brief description of the Riddell Herbarium].

Gray included *Nabalus asper* in the *Synoptical Flora of North America* (1884). Louisiana is mentioned there only as part of the distribution. Various other authors — Small (1933), Fernald

(1950), and Steyermark (1963) — have included Louisiana within the distribution of the species, under either *Nabalis* or *Prenanthes*.

Cronquist (1980) included Louisiana in the distribution of the species, but without further comment. This reference is most often cited by Louisiana authors as the basis for including the species as part of the flora of the state. MacRoberts (1984) referenced Riddell (1852) for including *Nabalis asper* in his checklist. MacRoberts (1988) and Thomas and Allen (1996) both cited Cronquist as the source for inclusion of *N. asper* in their checklists of the Louisiana flora. Gandhi and Thomas, in *Asteraceae of Louisiana* (1989), included the species in their treatment, based upon Cronquist (1980) and commented “but we located no LA specimens.”

Finally, Bolger (2006) cited Louisiana within the distribution of the species, without additional comment.

In summary, the species has been cited many times as occurring in Louisiana but has never been documented by reference to a collection. Only one citation (Torrey and Gray 1843) has claimed to be supported by an actual specimen, but it did not include any additional information.

An inquiry to the Gray Herbarium resulted in location of a specimen of *Nabalis asper* from Louisiana. The specimen was made available for study through an e-loan (high definition digital photograph) and is reproduced here with permission (Fig. 1).

Two different collections are mounted on the sheet. David E. Boufford, Senior Research Scientist at GH, quoted in Singhurst et al. (1998) commented “it was his [Gray’s] practice, to save paper I suppose, to mount two or more plants [i.e., different collections] on a sheet.” The two specimens can be distinguished by the age/condition of the plant at time of collection and the differences in the stem cuts. The three stems on the left side of the sheet make up a specimen of *Nabalis asper* collected in Kentucky. These were collected by C.W. Short (or possibly were only part of his herbarium) and are not part of this study. The three stems on the right are also *N. asper*, as is written on the label. The location is given as “Louisiana.” (in type) followed by the name of the collector, “Hale” (in script) [quotes added]. The collector is Josiah Hale, a student of Rafinesque, physician, and botanist (Ewan 1977). There is no further location or date. Ewan mentioned that problems persist in fixing collecting localities of Hale’s specimens. It is, however, possible to determine an approximate time and place of collection.

The following brief account of Hale’s life is extracted from Ewan (1977). In 1825, Hale settled on the Red River in Rapides Parish, 20 miles south of Alexandria. In 1828, he moved to Alexandria, where in 1830 he reported on the yellow fever epidemic in Alexandria in the *Transylvania Journal of Medicine*. He retired from medical practice in 1834 to devote full time to botany and the pursuit of natural history. In 1838, Torrey and Gray acknowledged “Dr. Hale of Alexandria” with citations that were followed by the exclamation mark (!), meaning they had seen his collections. In 1849, because of financial crisis, Hale returned to practicing medicine. In 1850, he moved to New Orleans.

Apparently a large portion, or possibly most, of Hale’s collections from Louisiana were made during his tenure in Alexandria and Rapides Parish. His collection of *Nabalis asper* was cited by Torrey and Gray (1843), thus was collected prior to that date. The collection year could be from 1825 to 1842 but would seem more likely to be after 1834, when he supposedly devoted full time to botany. The most likely location would be in or near Alexandria, Rapides Parish, but almost certainly in central Louisiana.





Figure 1. *Nabalus aspera* (Hale s.n., GH), the three stems on the right. The three stems on the left are *Nabalus aspera* from Kentucky (Short s.n., GH). This image belongs to the Digital Collection of the Harvard University Herbaria <[http://www.huh.harvard.edu/collections/digital\\_coll.html](http://www.huh.harvard.edu/collections/digital_coll.html)>



There has been skepticism, at least among the authors, as to the occurrence and collection of *Nabalus asper* in Louisiana, which just does not seem to be a favorable location. The species has a distribution that closely matches the tall grass prairie (Bolger 2006), resulting in it being considered as a tall grass prairie species. However, there are in Louisiana about 16,000 ha of isolated prairies (MacRoberts et al. 2003), mostly in the northern half of the state (Rapides Parish and northward). Generally, these isolated prairies are less than 5 ha and are most similar to “true prairie” and “central Texas” types. Several such prairies occurred in Rapides Parish and would appear to be a likely place of occurrence for the *Nabalus* species. MacRoberts et al. (2003) mentioned that 99% of the isolated prairies have been destroyed, which would suggest that *N. asper* has been extirpated from the state, should it have occurred in this type of area. The Louisiana record is best considered to be historical.

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## A NEW COMBINATION IN *DITHRIX* (ORCHIDACEAE)

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### ABSTRACT

The orchid genus name *Dithrix*, which was validated by R.K. Brummitt in 1993 and typified with *Habenaria griffithii* Hook. f., renders superfluity and illegitimacy to the recently published genus name *Nujiangia* X.H. Jin & D.Z. Li, which is also typified with *H. griffithii*. The new combination *Dithrix griffithii* (Hook. f.) Ormerod & Gandhi is made.

**KEY WORDS:** *Dithrix*, “*Habenaria decipiens*,” *Habenaria griffithii*, *Habenaria* sect. *Dithrix*, *Nujiangia*, *Nujiangia griffithii*

Hooker (1890: 133, 165) validly published the name *Habenaria* sect. *Dithrix* Hook.f. and included a single species “*H. decipiens* Hook.f.” He referred to “Hook.f., Ic. Plant. ined. – *Hermintum*, Griff. Notul. iii. 270; Ic. Plant. Asiat. t. 285 f. 1” and cited the following type information: North-West India; *Edgeworth s.n.*, alt. 3000 ft; Lahul (India), alt. 4-5000 ft., *Thomson s.n.* — Distrib. Afghanistan, *Griffith*, (Kew Distrib., 5326) Kurrum Valley (Pakistan), *Atchinson* No. 322.

Had Hooker (1890: 165) published his new species name “*H. decipiens*,” it would be a later homonym and illegitimate (non Wight 1851). He (p. 197), however, realized his mistake and renamed his “*H. decipiens*” as *H. griffithii* Hook. f. Since both “*H. decipiens* Hook. f.” and *H. griffithii* were proposed within the same publication and since “*H. decipiens* Hook. f.” was rejected, “*H. decipiens* Hook. f.” was not validly published and does not have any nomenclatural standing. The International Plant Name Index (2012), however, had indexed *H. decipiens* Hook. f. but had not indexed *H. griffithii*.

In his orchid treatment, Renz (in Rechinger 1978: 64) cited “*Griffith 5326*” from Afghanistan as the type. Since Hooker (1890: 165) cited syntypes, Renz’s citation “*Griffith 5326*” as the type amounts to an inadvertent lectotypification. As Hooker mentioned, “5326” is not Griffith’s collection number but is Kew’s distribution number. Although Renz did not cite the herbarium housing the type, it is reasonable to assume that the type is at K. In a personal communication, Andre Schuiteman (K) informed us that Griffith’s collection number is 424 and that there are 2 specimen sheets of this number. Upon our request, Schuiteman provided digitized images of the 2 sheets for our study.

Since there are 2 sheets of Griffith’s collection at K and since Renz did not cite the name of the herbarium housing the lectotype, his (1978: 64) inadvertent lectotypification is treated here as the first step of the lectotypification process. Of the 2 sheets, one (barcode K000796944) bears a label showing the no. “5326,” 6 specimens, and Hooker’s penciled floral drawings, and the other (barcode K000796945) bears 2 specimens. We here select the sheet (barcode K000796944) as the lectotype

(second-step).

Kraenzlin (1899), within his orchid treatment, placed *Diphylax* Hook. f. (a genus (including *Tsaiochris* Tang & F.T. Wang) of 3 or 4 species with a distribution range Himalaya to South China; Mabberley, 2008: 278)) and *Platanthera* Rich. (a genus of 200 species (including *Piperia* Rydb.), predominantly Northern Hemispheric; Mabberley, 2008: 676) next each other; he transferred *Habenaria griffithii* to *Diphylax* and made the new combination *D. griffithii* (Hook. f.) Kraenzl.

Jin & al. (2012), based on molecular data and morphological evidence, found that *Habenaria griffithii* is also close to *Gemmara* Parl. (a monospecific genus restricted to the western Mediterranean and Macaronesia; Mabberley 2008: 354) and *Peristylus* Blume (a genus of 70 species distributed in China to the Pacific (Mabberley 2008: 648) and that *H. griffithii* is closest to *Gemmara*. Their finding supports placing *H. griffithii* in its own genus.

Schlechter (1926: 583) listed "*Dithrix* Schltr." He neither provided a description/diagnosis nor referred to Hooker (l.c.) even indirectly. Therefore, "*Dithrix* Schltr." was not validly published.

Soó von Bere (1929: 369) used "*Dithrix* Schlecht." and "*D. decipiens* Hook.f. Fl. Brit. Ind. VI. 1890. 165." and referred to "*(Habenaria decipiens* Hook. f. l.c. – *Hermnum decipiens* Griff. Notul. III. 370.) – non Wight, *H. Griffithii* Hook. f. l.c. 197" (sic). He did not provide a description/diagnosis for "*Dithrix* Schlecht." or refer to *H. sect. Dithrix*. Therefore, he did not validate "*Dithrix* Schlecht." Because of the invalidity of "*Dithrix* Schlecht.," "*D. decipiens*" was also not validly published. Furthermore, "*Hermnum decipiens* Griff." does not exist. Griffith (posthumously) published "*Hermnum* sp." (Griffith, 1851a: 270; 1851b: t. 285).

In spite of their invalid status, both "*Dithrix* Schltr." and "*Habenaria decipiens* Hook. f." were indexed by the Index Nominum Genericorum (Plantarum) (2012), and the Names in Current Use for Extant Plant Genera (2012) indexed both as follows:

**Dithrix** (J.D. Hooker) Schlechter, Notizbl. Bot. Gart. Berlin-Dahlem 9: 583. 22 Jul 1926.

*Habenaria* sect. *Dithrix* J.D. Hooker, Fl. Brit. Ind. 6: 133. Dec 1890.

**TYPE:** *Habenaria decipiens* J.D. Hooker 1890, non R. Wight 1851

The above data are included in the printed version of the Names in Current Use for Extant Plant Genera (Greuter & al. 1993: 366). The inclusion of *Dithrix* as an accepted generic name and the citation of a full reference to the basionym validate the generic name. On preface page XIII, R.K. Brummitt is credited for the data on vascular plant generic names. Therefore, Brummitt is author of the orchid genus *Dithrix*. The citation of "*Habenaria decipiens* J.D. Hooker" as the type species is treated as a correctable error for *H. griffithii* Hook. f. [In contrast, the International Plant Names Index (2012), had not indexed "*Dithrix* Schltr."]

Unaware of the inadvertent validation of *Dithrix* in 1993, Jin and Li (in Jin & al. 2012: 68-69) published the genus name *Nujiangia* X.H. Jin & D.Z. Li and typified it with *Habenaria griffithii*. They also made the new combination *N. griffithii* (Hook. f.) X.H. Jin & D.Z. Li. Besides the localities cited by Hooker, they added Yunnan, China to the range of this species. Since *Dithrix* and *Nujiangia* are typified by the same species, *Nujiangia* is superfluous and illegitimate.

We hereby transfer *Habenaria griffithii* to *Dithrix* and make the new combination *Dithrix griffithii*. A summary is provided below.

*Dithrix* (Hook. f.) Schltr. ex Brummitt, Regnum Veg. 129: 366. 1993. BASIONYM: *Habenaria* sect. *Dithrix* Hook.f., Fl. Brit. Ind. 6: 133, 165. Dec 1890. *Nujangia* X. H. Jin & D. Z. Li, J. Syst. Evol. 50(1): 68. 2012, nom. superfl. & illegit. TYPE SPECIES: *D. griffithii* (Hook.f.) Ormerod & Gandhi (*H. griffithii* Hook.f.)

*Dithrix griffithii* (Hook. f.) Ormerod & Gandhi, comb.nov. BASIONYM: *Habenaria griffithii* Hook.f., Fl. Brit. Ind. 6: 197. Dec 1890. *Diphylax griffithii* (Hook. f.) Kraenzl., Orchid. Gen. Sp. 1(10): 599. 1899; *Nujangia griffithii* (Hook. f.) X.H. Jin & D.Z. Li, J. Syst. Evol. 50: 68. 2012. LECTOTYPE: Afghanistan. 1862-63, *W. Griffith* 424 (= Kew distribution no. 5326) (K) (first-step by J. Renz in K. H. Rechinger, Fl. Iran. 126: 64. 1978); K barcode no. K000796944 (second-step designated here).

Distribution: Afghanistan, China, India, and Pakistan.

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## **SELENIA AUREA NUTTALL (BRASSICACEAE) IN TEXAS: A REVIEW**

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### **ABSTRACT**

The occurrence of *Selenia aurea* in Texas is fully documented. The species is thus considered a part of the flora of Texas, at least in a historical sense. Photographs of documenting specimens, circumstances involving the time and place of collection, and commentary on the history of the species in the state are included.

**KEY WORDS:** Brassicaceae, Cruciferae, *Selenia*, Texas, San Augustine County, San Augustine, Ayish [Irish] Bayou Settlement, Weches Formation, glades and outcrops, Melines C. Leavenworth.

*Selenia* is a genus of five species, four occurring in the southwestern USA and one in northeast Mexico (Al-Shehbaz 2010). Four species are recorded in Texas, two being endemic to the state, another also occurring in New Mexico, and the fourth species, *S. aurea* Nuttall, mainly distributed in the Ozark and Ouachita highlands of the southcentral USA, is considered to be of questionable occurrence in Texas. The later species was cited by Torrey and Gray (1838) and Watson (1895) as occurring in Texas and, more recently by Martin (1940), Correll and Johnston (1970), Rollins (1993), and Al-Shehbaz (2010) as probably occurring in Texas. Turner et al. (2003) excluded the species from the state. The purpose of the study is to determine if *S. aurea* can be documented in Texas and thus clarify the southwestern distribution of the species.

The major references, with commentary, concerning *Selenia aurea* in Texas include the following.

The first mention of the occurrence of *Selenia aurea* in Texas was by Torrey and Gray (1838), where it is treated as *S. aurea* var.  $\beta$ . The following specimen is cited: "Near St. (sic) Augustine, Texas, Dr. Leavenworth." There are irregularities associated with the citation. Martin (1940), in citing the specimen, writes that "No sheet has been seen that corresponds to these data. There is in the herbarium of the New York Botanical Garden (from the Torrey Herbarium) a collection labeled "*Selenia aurea*. —(?) Prairies, Texas." The question mark is in place for a word unreadable by Martin. No specific location is

given. Additionally, the St. (English or French, saint) should be San (Spanish, San, masculine of saint), as there is a San Augustine but no St. Augustine in Texas. These items will be addressed further in the discussion of the herbarium specimens cited below.

In 1895, Sereno Watson (in Gray 1895) cited the above specimen in proposing the name *Selenia aurea* var. *aperta* for var.  $\beta$  of Torrey and Gray. He also cited the specimen data as "Near St. Augustine, Texas, Leavenworth," indicating that the transaction was based solely on literature.

Martin (1940) presents an excellent account of the species, which includes a summary of the circumstances of the Leavenworth specimen mentioned above. He concludes with saying that the species is "probably in Texas." This disposition is likely the result of the inconsistencies of the Leavenworth specimen.

By inclusion in their manual, Correll and Johnston (1970) treated *Selenia aurea* as part of the flora of Texas. The distribution was given as "probably n.e. Tex." This distribution may be taken in two ways. A northeast Texas distribution would be contiguous with the distribution (which included eastern Oklahoma and in particular, Choctaw County, which borders Texas) mapped by Martin (1940). Or possibly it may only be an expression of uncertainty, since the Texas record may not be supported by a specimen. Thus the species was included in the flora in deference to the citations by Torrey and Gray (1838), Watson (1895), and possibly Martin (1940).

Rollins (1993) questioned the exact southwest limits of the species, having not seen specimens from Texas or Louisiana. [Rollins' mention of Louisiana has nothing to do with the present paper and was dismissed as extraterritorial (not from present day Louisiana, but from the Louisiana Purchase territory).]

The species was included as part of the flora of Texas in various checklists of the vascular flora of the state. Included here are the works of Cory and Parks (1937), Gould (1962), Johnston (1990), Hatch et al (1990), and Jones et al. (1997). There are presumably based upon literature reports, hence specimens are not cited.

Turner et al. (2003) did not map the species as part of the flora of the state in the Atlas of the Vascular Plants of Texas (Vol. 1), thereby excluding the species as part of the Texas flora.

Al-Shehbaz (2010) mentioned that "Although R.C. Rollins (1993) and R.F. Martin (1940) suggested that *Selenia aurea* probably occurs in southeastern Texas, I have not seen any material from that state."

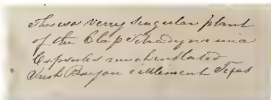
In summary, the question still remains. Only one specimen of *Selenia aurea* has been cited from the state, but the record cannot be verified because there is no specimen that corresponds to the data given (see Torrey and Gray 1838, above). In essence, the location cited by Torrey and Gray does not accompany the specimen. A specimen from Texas cited by Martin (1940) appears to be the same sheet mentioned by Torrey and Gray (1838) but with accurate label data that does not give a specific location.

The purpose of this paper is to determine if *Selenia aurea* should be considered part of the flora of Texas and thus resolve the question of the southwestern limit of distribution of the species. The research included field searches for the species in two areas of the state. This included San Augustine and Sabine counties of east central Texas, the area collected by M.L. Leavenworth in the 1830s. The second area was northeast Texas (particularly Lamar and Fannin counties), which is continuous with the distribution cited by Martin (1940) and cited as the part of the state where the species is most likely to be expected. The species was not relocated. The second part of the study was to locate and study herbarium specimens of *S. aurea* from Texas. Four specimens were located and accessed via ultra definition digital

photographs (shown). Two of these photographs provided information important to resolving the issue and are included in this paper. The other two specimens are fragments lacking original label data.

Figure 1, from the Academy of Natural Sciences at Philadelphia (PH), provided the most important information. The specimen had the most plant material and a label written in the hand of the collector, Melrose C. Leavenworth. There are several annotations confirming the determination as *Salweenia* across and a label in the lower right corner stating that the specimen, originally a part of the herbarium of C. W. Short, was presented to the Academy of Natural Sciences by Short's estate in 1884.

Following is an enlarged digital copy of the label (see Fig. 1):



The label, in the hand of Leavenworth, reads:

This is a very (as) singular plant  
of the class Tetradymnia  
Capsules much inflated  
Irish Bayou Settlement Texas

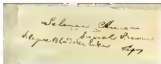
It is not known what is meant by "very singular plant of the class Tetradymnia." It probably refers to the inability to place the genus in any known "tribe" so it was given a place by itself (Horn, Torrey and Gray 1838). Certainly, it may only refer to the rarity of the species in Texas or that only one plant was present (but the presence of numerous individual roots makes this unlikely). Class Tetradymnia was used at that time as the name of what is the Brassicaceae today. There is also the only label among the four specimens that gives a "precise" location of the collection site, Irish Bayou Settlement. Unfortunately there is no such named place in Texas. This is, however, Leavenworth's rendering of the place named Ayish Bayou Settlement. The word Ayish seems to be the English adaptation of the name of the aboriginal people variously known as the Aai, Aya, or Eynah (as in Mission de Nuestra Señora de los Dolores de las Aai founded in 1716 near what is now San Augustine [Dorsey & Caldwell 1993]) as to the name and founding date, but not the translation of Aai. Ayish Bayou is named after the Ayish Indians, who lived next to the waterway so named. The stream originates in Shelby County, Texas, and flows south through San Augustine County (and the town of San Augustine). It is (originally) a tributary of the Angelina River, but now empties into San Rayburn Reservoir. Finally, the word Texas in script, with its distinctive bold slash through the x, was used in identifying the writing of Leavenworth.

A collection date is not given, but the approximate date of collection can be determined. Texas, prior to 1836, was part of Mexico. Prior to 1834 the area (now San Augustine) was known as Ayish Bayou Settlement. In 1834, the municipality of San Augustine was established by Mexican law; the name



being chosen by the Mexican government to honor San Augustine of Hippo (McCroskey 2012). If Leavenworth collected the plant before 1834, he would have cited the location as Ayash Bayou Settlement, but as San Augustine if in 1834 or later. From October 1831 to 1833, Leavenworth, a surgeon in the United States Army, was stationed at Camp Jearup (later Fort Jearup, Sabine Parish, Louisiana (McVaugh 1947). A road, [sic] El Camino Real (King's Highway) connected Natchitoches, Louisiana, to the Presidio de Nuestra Señora del Pilar de las Adas (capital of Texas from 1729 to 1763; Ocasio & Caldwell 1995). Camp Jearup, Ayash Bayou Settlement (San Augustine), Hockleyches, San Antonio, then to Mexico. The distance between Camp Jearup and Ayash Bayou Settlement (San Augustine) is approximately 80 km, as measured on today's highways, Louisiana Highway 6 and Texas Highway 21. These basically follow the path of the original El Camino Real. McVaugh (1947) mentioned that nothing is known about Leavenworth's botanical activities during this tour of duty at Camp Jearup, but it certainly does not preclude that he could have traveled to Ayash Bayou Settlement. When considered in view of the renaming of the settlement as San Augustine, a collection date of 1831–1833 is probable.

The second specimen (Figure 2) of note is from the Torrey Herbarium of the New York Botanical Garden (NY's specimen ID 147374). It is not known how NY obtained this specimen, but most likely it was sent to Torrey by Short and is a duplicate of the Leavenworth specimen discussed above. Following is a digital copy of the label (see Fig. 2).



The label does not give a specific location, collector, or date. The handwriting, along with the boldly slanted *z*, clearly reveals the handwriting of Leavenworth, thus the collector. The first line of the label gives the place name. The second line, not understandable by Martin (1940) and as referenced in his paper as "(?) Prunus" is translated here to "gravel." Thus the complete phrase is "Gravel (or) Prunus" which does not refer to a place name, but to the gravelly nature of the surfaces of rock glades (outcrops of the Weches Formation) in that part of Texas, the habitat of the species. The rock glades, consisting of glaucous, sandstone, and/or carbonate, were (and are) devoid of trees and appeared as "prunes" in the virgin forest of the time. The surfaces are strewed with gravel. (Indications are that Leavenworth has some problems of spelling, as in "very" above and now "gravel.") On the third line, prior to Texas, is written "Sabine Parish, La."

Apparently, this is the specimen cited by Torrey and Gray (1838) as "Near St. [sic] Augustine, Texas, Dr. Leavenworth," as it appears to be the only specimen that they had access to. Obviously, since the specimen does not give a specific location, the location cited in Torrey and Gray (1838) was obtained from another source. In doing so, Torrey and Gray (1838) erred in citing the name as St. Augustine rather than San Augustine. The addition of the word "near" possibly reflects uncertainty as to if Ayash Bayou Settlement was incorporated into San Augustine in 1834. The failure to transcribe the label data accurately without giving indication of such in the manuscript under review to enter this on the herbarnia sheet may be the root cause of the uncertainty concerning the occurrence of the species in Texas.



Figure 3. *Delonix regia* (U-M Herbarium). a) Photocopy, Herbarium U-M, Botany Department, Academy of Natural Sciences/Philadelphia. Information provided with the permission of The Academy of Natural Sciences



There are two additional specimens at the New York Botanical Garden (NY Specimen ID 1477275 and 1477276). These sheets, both containing fragments of a fruiting branch, have "C.W. Short M. D." labels identifying the specimens as being from Texas. This may be in the hand of C.W. Short, but is definitely not in the hand of Leavenworth. This seems to support that these fragments were part of the original Leavenworth collection and were distributed as follows. New York Specimen ID: 1477275 was originally given to Princeton University and incorporated into NY in 1945 while NY Specimen No. 1477276 was given to Wesleyan University and deposited in NY in 1981.

In summarizing the findings obtained through study of the digital photographs, we consider the following to be important.

1. Four specimens were located, two having original data important to the study, while the other two had no original information.
2. In our opinion, all specimens are duplicates of the same collection (unicate) made between 1831 and 1833. The specimens were sent to C.W. Short, who distributed fragments to other herbaria.
3. The collection was made at or near Ayish Bayou Settlement (now San Augustine, San Augustine County), Texas. The collection was split as noted.
4. The specific habitat was a rock outcrop/glade of the Weches Formation.

The one specimen from the Academy of Natural Sciences (PH), which has been historically documented in this paper, verifies the historical occurrence of *Selenia aurea* in Texas. The Torrey specimen (NY Specimen ID: 1477274) provides corroborative information. Thus, the southwestern limits of the species include central deep east Texas.

Finally, comments on the possibility of rediscovery of the species in Texas are appropriate. In short, this is highly unlikely, largely because of habitat loss, the rock outcrops/glades of this part of Texas having been mined for rock used on local roads. Those remaining intact are in less than pristine condition, largely due to invasion by non-native woody plants such as *Rosa bracteata* (Rosaceae), *Ligustrum sinense* (Oleaceae), and *Lonicera japonica* (Caprifoliaceae) or are privately held, thus have limited or no access. However, the hope remains that the species may still be found in the state, probably in northeast Texas.

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NOTES ON TWO RARE *SOLIDAGO* (ASTERACEAE) IN TENNESSEE:  
*S. ARENICOLA* AND *S. SIMPLEX*

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ABSTRACT

*Solidago simplex* subsp. *randii* var. *racemosa* is reconfirmed as a member of the Tennessee flora. *Solidago arenicola* is similarly confirmed although there are minor morphological differences between the Tennessee plants and typical plants from Alabama. *Solidago arenicola* in Tennessee is disjunct by about 300 kilometers from the type locality in Alabama and by about 370 kilometers from a reported occurrence in Kentucky, the only other known areas of distribution for the species. *Solidago simplex* and *S. arenicola* in Tennessee are distributed on two separate river systems of the Cumberland Plateau.

**KEYWORDS:** *Solidago arenicola*, *Solidago racemosa*, Tennessee, Obed River, Big South Fork

The recent floristic checklist of Tennessee (Chester et al. 2009) reported *Solidago arenicola* Keener & Kral based on material from two counties, Morgan and Scott, both of the Cumberland Plateau physiographic province where they grow along river-scoured rocky margins or on cobble bars. The present report of *S. arenicola* in Tennessee is due to the referral of the Tennessee populations to that species by Semple and Cook (2006) and their suggestion that the identity of the plants needs confirmation.

Specimens at TENN were annotated to *Solidago arenicola* by Dwayne Estes based on a presumption of their identity fide Semple and Cook (2006) and their comparison to an isotype at TENN. Peirson et al. (2012) confirm the presence of *S. arenicola* in Tennessee based on cytological data that shows the Tennessee and Alabama populations are tetraploid ( $2n = 36$ ) and morphologically similar. Formerly, all of these specimens had been annotated as *S. erecta* Pursh, *S. spatulata* DC., a variety or subspecies of *S. simplex* Kunth., or as *S. uliginosa* Nutt. Chester et al. (1997) treated all as *S. simplex*. For both Scott and Morgan counties, other accounts include either *S. simplex* (USDA, NRCS, 2012) or *S. arenicola* (Semple & Cook 2006; BONAP 2011).

Examination of Tennessee material annotated as *Solidago arenicola* indicates that two distinct taxa are represented by these collections — one tentatively identified as *S. arenicola* (having glabrous cypselae), the other as *S. simplex* Kunth subsp. *randii* (Porter) Ringius var. *racemosa* (Greene) Ringius (with strigose to shortly pubescent cypselae).

*Solidago arenicola* was described from a single population in Alabama (Keener & Kral 2003). Its habitat is sandy alluvium of the Locust Fork River shore, where inundation and drought both are frequent during summer. *Solidago arenicola*, *S. kralii* Semple, and *S. plumosa* Small (all of subsect. *humiles* (Ryd.) Semple) have glabrous cypselae (Keener & Kral 2003). *Solidago arenicola* is distinguished from *S. plumosa* by its small capitula and longer cypselae and from *S. kralii* which has leaves and arrays abundantly viscid.

In Tennessee, *Solidago arenicola* occurs in Morgan County along the Obed River and tributaries, which drain to the Emory River. It is disjunct to sandy bottoms of Whites Creek in Roane County which is downstream from where the Emory and Clinch Rivers drain into Watts Bar Lake, a reservoir damming the aforementioned rivers and the Little Tennessee which eventually reaches the Mississippi drainage via a circuitous route through Alabama. It is in Alabama that this river system approaches the Alabama populations of *S. arenicola*. It is likely that this route assisted the species migration and evidence of this may be recovered from molecular phylogeographic work. In contrast, *S. simplex* var. *racemosa* occurs along a limited area of the Big South Fork of Scott County which drains northward into the Cumberland River and thence to the Mississippi drainage.

Recognition of *Solidago arenicola* in Tennessee remains problematic, however, due to morphology outside the ranges of the original species description. Although the Tennessee plants key to *S. arenicola* and share the larger capitula with fewer per inflorescence following Keener & Kral (2003), they differ in several morphological features (Table 1). Significantly, the involucre in the specimens examined are never longer than 7–8 mm, whereas in typical *S. arenicola* they can reach 12 mm. Moreover, the disc floret number is consistently less (6–10) than in *S. arenicola* (11–16) from the type locality. Glandular vestiture in the inflorescence of *S. arenicola* was noted by Keener and Kral (2003) but an isotype (TENN) does not show minute glands at 40x magnification. Glandular vestiture is not discernible on live plants (cultivated) of the Tennessee plants. Nonetheless, *S. arenicola* from Alabama and Tennessee are cytologically similar (Peirson et al., 2012).

The distinction of the Tennessee plants from *Solidago erecta* (subsect. *Squarrosae* A. Gray) is unambiguous. Plants of *S. arenicola* in Alabama and Tennessee are rhizomatous, forming numerous basal rosettes from slender rhizomes terminating in caudiciform growth; those of *S. erecta* have an erect, non-rhizomatous root. Both the Tennessee plants and typical *S. arenicola* have glabrous leaf margins, while *S. erecta* has scabrellous margins. Also, compared to *S. erecta*, *S. arenicola* has fewer heads per stem, longer involucre, and more disc flowers per head (Table 1). *Solidago erecta* occurs in dry uplands while the others occur in wet, sandy bottoms.

	<i>arenicola</i> (Tenn.)	<i>arenicola</i> (Ala.)	<i>erecta</i>
rhizome	horizontal	horizontal	erect
heads per stem	15–95	10–50	15–350
leaf margin	glabrous	glabrous	ciliate-scabrellous
inflorescence vestiture	eglandular	glandular	eglandular
involucre length (mm)	7–8	7–12	3.5–6.5
ray florets	8–10	6–10	5–9
disk florets	6–10	11–16	6–10
corolla length (mm)	4–5	5–6	3–4
cypselae (mm)	3–4	1.5–4	2.5

Table 1 Comparison of relevant morphological features between *Solidago arenicola* in Tennessee, typical *S. arenicola* from Alabama, and *S. erecta*. Data are taken from specimens at TENN and from Semple and Cook (2006) and Keener and Kral (2003).

Dissimilarities place the Tennessee plants outside of the circumscription of *Solidago erecta*, but ecology and morphology suggest that they are closely related to *S. arenicola* and they are included here in a broadened taxonomic concept of *S. arenicola*. Alternatively, the taxonomic

status of these plants in Tennessee should be further investigated toward the possibility that they have arisen independently of *S. arenicola* in Alabama.

Collections examined. *Solidago arenicola*. USA. Alabama. Blount Co.: 1.5 air mi WNW of Cleveland, 7 Sep 2002, *Kral 93190* (isotypes: image MO, image NCU, TENN). Tennessee. Morgan Co.: Obed National Wild and Scenic River Park, 4.2 air mi SW of Wartburg, where Catoosa Rd crosses Emory River at Nemo Bridge, N of Bridge on W side of river, sandy cobble bar, 36° 04' 10" N, 84° 39' 47" W, 12 Oct 2005, *Estes, Wofford, and Beck 08551* (TENN); same location and date, *Estes, Wofford, and Beck 08548* (TENN); common boulder bar element along N bank of Obed River just upstream from McMilligan Branch, Lancing Quad (1967), 29 Sep 1980, *Patrick & Schmalzer 1607* (TENN); gravel bar with shrub-herb community on S of Clear Creek about 0.4 mi downstream from bridge on St. Rt. 4252 (Jett Bridge), Lancing Quad, 20 Aug 1980, *Schmalzer 1615* (TENN); Clear Creek at Lilly Bridge, mesic slopes, 17 Sep 1989, *McNeish 89-1038* (TENN); sandy soil along Emory River at Camp Austin N of Oakdale, 16 Sep 1970, *Somers., Bowers, and Wofford 46460* (TENN); sandy soil along Clear Creek, just SW of bridge along Hwy 4252, ca. 5 mi W of Lancing, 29 Aug 1977, *Webb, Wofford, and Patrick 1069* (TENN); gravel bar with shrub-herb community on E side of Emory River just upstream from Nemo Bridge, Lancing Quad, 1 Oct 1980, *Schmalzer 1617* (TENN). Roane Co.: sandy bottoms along Whites Creek, 13 Oct 2010, *Pounds s.n.* (TENN).

*Solidago simplex*. USA. Tennessee. Scott Co.: Big South Fork National River and Recreation Area, growing along sandy shore on E bank of BSFR, near Angel Falls, 15 Sep 2001, *Durr s.n.* (TENN); BSFR, 0.5 mi downstream from Leatherwood Ford, 14 Oct 1988, *Schell s.n.* (TENN); BSFNRRA, bank of the Clear Fork of the Cumberland River, 36° 24' 48" N 84° 37' 24" W, 1 Sep 1999, *Beck 478* (TENN); open, gravel and boulder areas along the BSF, Honey Creek Pocket Wilderness area, 12 Sep 1984, *Wofford 84-57* (TENN); BSF 2 mi up from Leatherwood Ford at O&W RR trestle, rocky bars and banks, bracts yellow-green, 14 Oct 1978, *Somers 1577* (TENN).

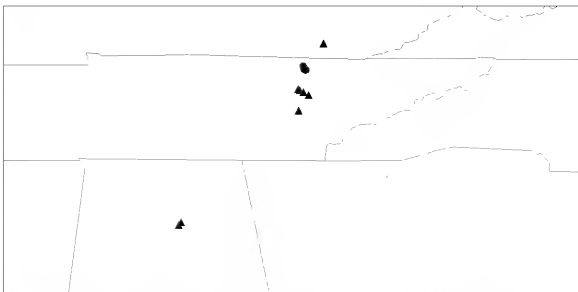


Figure 1. Distribution of *Solidago arenicola* (triangles) (KY site not seen, J. Peirson, pers. comm.) and *S. simplex* (circles) in Tennessee, Alabama, and Kentucky. Map created using <http://www.simplemapp.net/>



## ACKNOWLEDGEMENTS

I thank Larry Pounds for his 2010 collections of *Solidago arenicola* from Roane County, which spurred the investigation and comparison of specimens at TENN, in turn leading to the examination of specimens discussed representing two distinct taxa. I also thank Guy Nesom for his comments on the manuscript.

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**MONTANOA SERBOANA (ASTERACEAE: HELIANTHEAE),  
A NEW SPECIES FROM OAXACA, MEXICO**

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**ABSTRACT**

A novel taxon, *Montanoa serboana* B.L. Turner sp. nov., is described from Distrito Pochutla in Oaxaca, Mexico. It is reportedly a tree to 8 meters high, possessing characters of sect. *Montanoa* but differing in numerous traits, including few-flowered, rayless heads and glabrous leaves with entire margins. A photograph of the type is provided, along with maps showing its distribution in comparison to other species of *Montanoa* growing in the state of Oaxaca.

**KEY WORDS:** Asteraceae, Heliantheae, *Montanoa*, Mexico, Oaxaca

Identification of Mexican Asteraceae received at herbarium TEX-LL has occasioned the present paper.

**MONTANOA SERBOANA** B.L. Turner, sp. nov. Figure. 1 **TYPE:** MEXICO, Oaxaca. Distrito Pochutla, Mpio. San Miguel del Puerto: En la vereda que va al cafetal Arroyo Arena, ca 150 degrees and 1.47 km from Rancho “Dioon,” selva mediana subperennifolia con café, ca 600 m, “11/12/2003,” *Arturo Nava Zafra 243* [with Sanchez, Salas, and Pascual] (holotype: TEX).

Similar to *Montanoa tomentosa* Cerv. but arborescent, heads eradiate, disk florets 3–5 per head (vs 6 or more), corollas minutely glandular-pubescent, and leaves glabrous with entire margins (vs variously pubescent and usually trilobed”).

Tree up to “8 m” tall. Stems (uppermost) rounded, glabrous. Leaves glabrous; petioles 3–4 cm long; blades broadly lanceolate to somewhat elliptic, mostly 12–20 cm long, 4–6 cm wide, grading into the petioles, 3-nervate from ca 1 cm above the base, margins entire. Capitulescence a terminal or axillary cymose panicle, 10–12 cm long, 5–8 cm wide; primary peduncles 2–4 cm long, ultimate peduncles mostly 2–4 mm long, pubescent with spreading hairs 0.5–1.0 mm long. Heads 4–5 mm high; involucre 1–2 seriate, ca 2.5 mm long, 2–3 mm wide (at anthesis), composed of ca 5 subequal bracts; pales ovate, apiculate, ca 2.5 mm long, villous with white hairs 1–2 mm long. Ray florets absent. Disk florets 3–5 per head; corollas reportedly “white,” ca 2 mm long; minutely glandular-pubescent, the hairs intermixed with sessile atomiferous glands; corolla tubes ca 1 mm long, throat abruptly campanulate, ca 1.5 mm long, lobes ca 0.7 mm long. Anthers yellow, appendages ca 0.5 mm long. Achenes (immature) epappose, glabrous. Known only from the type collection.

The name of the species is an acronym derived from Sociedad para el Estudio de los Recursos Bioticos de Oaxaca (SERBO), which supported the collection of the type of *Montanoa serboana*.

This is a remarkable and unexpected novelty in *Montanoa*, considering the relatively recent systematic treatment of the genus by Funk (1982). By characters of the pales and florets, it appears

Figure 1. Holotype of *Montanoa serboana* B.L. Turner.

to belong to the sect *Montanoa*, differing by having different foliage (blades broadly lanceolate, glabrous and entire) and few flowered, rayless heads. Within the section, *M. serboana* presumably relates to *M. tomentosa* Cerv. Few-flowered rayless heads were reported in reduced individuals of *M. tomentosa* by Funk (1982, p. 39), such plants having previously been described (based only upon their types), as species (*M. gentryi*, *M. hemsleyana*, and *M. rekoii*). The present novelty differs from all such variants of *M. tomentosa* in having different leaves and florets. Additionally, it is reportedly a tree up to 8 m tall, while most members of sect *Montanoa* are described as "Much branched shrubs 1–3 m tall" (Funk 1982).

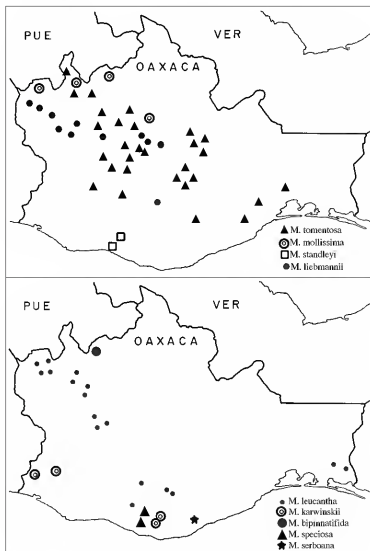


Figure 2. Distribution of *Montanoa* species in Oaxaca, Mexico.

With the description of *Montanoa serboana*, nine species of the genus are known to occur in the state of Oaxaca (Maps 1 and 2), one of these endemic (*M. serboana*) and two nearly so (*M. liebmannii* and *M. standleyi*), making the state a "Montanoan Paradise," no other state or area of Mexico possessing such a spectacular display of taxa.

#### ACKNOWLEDGEMENTS

I am grateful to my field companion Jana Kos for editorial assistance and to my colleague Jose Panero for his professional input. Distribution maps are based upon specimens on file at LL-TX and those cited by Funk (1982).

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**GLANDULARIA MALPAISANA (VERBENACEAE),  
A NEW SPECIES FROM SONORA, MEXICO**

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**ABSTRACT**

*Glandularia malpaisana* Van Devender & Nesom, sp. nov., is described from basalt flows west of Moctezuma in east-central Sonora, where it apparently is endemic. It is distinct in its annual duration, small stature, stipitate-glandular stems and leaves, ovate leaf blades with toothed to shallowly lobed margins, short inflorescences, calyces 5–6 mm with shallowly deltate to subtruncate lobes, corolla tubes 3–5 mm long and limbs 4–5 mm wide, and nutlets 2.5–2.8 mm, with a flanged, stipe-like base and with commissure reaching the apex. Color photos and comparisons to *G. gooddingii*, *G. pumila*, and *G. delticola* are provided.

**KEY WORDS:** *Glandularia malpaisana*, *Glandularia gooddingii*, *Glandularia pumila*, *Glandularia delticola*, Verbenaceae, Sonora, Mexico

The taxonomy of *Glandularia* in North America has been considered in detail in recent studies (Umber 1979; Turner 1998, 1999; Nesom 2010a, 2010b) following the broader study of *Verbena* sensu lato by Perry (1933). The new species described here was discovered in the *malpais*, an extensive basalt lava flow near Moctezuma, Mexico (Fig. 4), in February 2012.

***Glandularia malpaisana*** T.R. Van Devender & Nesom, sp. nov. Figures 1–3. **TYPE:** MEXICO. Sonora. Mpio. de Divisaderos: 10 km (by air) N of Tepache, 23.9 km (by air) SSE of Moctezuma, 29° 37' 29" N, 109° 31' 53" W, sparsely open foothills thornscrub on basalt cobble plain, 728 m elev., locally common annual, flowers pink, 15 Feb 2012, T.R. Van Devender 2012-195 with A.L. Reina-G. (holotype: ARIZ; isotypes: MEXU, TEX, others).

Distinct in its small stature, stipitate-glandular stems and leaves, ovate leaves with toothed to shallowly lobed margins, short inflorescences, calyces 5–6 mm with shallowly deltate to subtruncate lobes, corolla tubes 3–5 mm long and limbs 4–5 mm wide, and nutlets 2.5–2.8 mm with commissure reaching the apex and with a flanged, stipe-like base. Similar to *Glandularia gooddingii* (Briq.) Solbrig in its lobed to coarsely toothed leaves (vs. pinnatifid), stipitate-glandular stems, and distribution in western North America but different in its annual, slender-taprooted duration and habit with stems erect from the base, smaller leaves, and much smaller inflorescences, flowers, and fruits.

**Plants** annual, slender-taprooted. **Stems** erect to ascending from the base, 9–25 cm, simple or branching from the base, pilose-hirsute with stiff, sharp-pointed, eglandular hairs 0.2–1.2 mm, stipitate-glandular along the whole length with gland-tipped hairs 0.1–0.2 mm. **Leaves:** blades deltate to ovate or broadly ovate in outline, membranaceous, 1.5–2 times longer than wide, midstem



Figure 1. *Glandularia malpaisana*, habit and habitat. Photo by T.R. Van Devender, 15 Feb 2012.





Figure 2. *Glandularia malpaisana*, stem apices. Photo by T.R. Van Devender, 15 Feb 2012.



Figure 3. *Glandularia malpaisana*, inflorescence. Photo by T.R. Van Devender, 15 Feb 2012.



10–18 mm, hirsute-strigose to strigose adaxially, hirsute abaxially, sparsely stipitate-glandular on both surfaces, margins toothed to shallowly lobed, deepest lobes 1/3–1/2 to midrib, ultimate segments ovate to ovate-lanceolate, apices rounded; petioles 3–10 mm. **Inflorescence** 5–20 cm in flower, mostly remaining compact, elongating to ca. 10–25 mm in fruit; flowers 9–18; floral bracts half the length of the calyces. **Calyces** 5–6 mm, pilose-hirsute and minutely stipitate-glandular, lobes very shallowly deltate to subtruncate-mucronulate. **Corollas** pink, tubes 3–5 mm, sparsely pilose, limbs 4–5 mm in diam. **Nutlets** cylindric, 2.5–2.8 mm, not broadened at the base, mature color not seen, commissure reaching the apex, 3/4–4/5 as wide as the nutlet apex, apical appendage absent, base with thin-flanged stipe-like appendage.

The new species is only known from the extensive (ca. 275 km<sup>2</sup>) basalt flows south of the Sierra de la Madera and west of Moctezuma in east-central Sonora. The habitat is unique with regularly spaced black stones emerging from a dark, clay-rich soil derived from the eroding basalt. This soil becomes very sticky when wet and contracts when dry. The vegetation is foothills thornscrub, which occupies a broad area between Sonoran desertscrub to the west, tropical deciduous forest to the southeast, and oak woodland in the Sky Island mountain ranges and the Sierra Madre Occidental to the east. On the Moctezuma lava plain, foothills thornscrub is of short stature and the trees are small and widely spaced.

The Sierra la Madera, a Sky Island mountain range in east-central Sonora, Mexico, is an area of floristic interest for the Madrean Archipelago Biodiversity Assessment (MABA) program at Sky Island Alliance in Tucson, Arizona, and the Universidad de la Sierra (UNISIEERA) in Moctezuma, Sonora. Floristic observations and collections, including a MABA Expedition in August 2010, from the Municipio (= County) of Moctezuma are available online in the MABA database (Madrean.org), which is a node of the Southwestern Environmental Information Network (SEINet) database of herbarium collections.



Figure 4. Basalt lava flow west of Moctezuma, Sonora. Habitat of *Glandularia malpaisana*.

Other plants of interest from the lava plain include disjunct populations of *Viguiera purissima* Brandegee, a species of Asteraceae common in Baja California and southern California, and *Croton lindheimerianus* Scheele, a Chihuahuan Desert species found from Texas west to Arizona. The holotypes of *Melampodium moctezumum* B.L. Turner and *Verbena moctezumae* Nesom & Van Devender (2010) were collected in the same habitat.

In Sonora, Mexico, *Glandularia gooddingii* (Nesom 2010b) might be postulated as a close relative of *Glandularia malpaisana*, chiefly because of their non-pinnatifid leaves, but the two are distinguished by a number of unambiguous features, including the following.

1. Annual; midstem blades 10–18 mm; inflorescence elongating to 10–25 mm in fruit; corolla tubes 3–5 mm, limb 4–5 mm in diam; nutlet commissure reaching the apex ..... *Glandularia malpaisana*
1. Perennial; midstem leaf blades 20–50 mm; inflorescence elongating to 20–50(–80, –100) mm in fruit; corolla tubes 8–9(–10) mm, limb 10–14 mm in diam; nutlet commissure not reaching the apex ..... *Glandularia gooddingii* (Briq.) Solbrig

*Glandularia pumila* and *G. malpaisana* are similar in their small stature, small flowers, and ovate, non-pinnatifid leaves, but the two perhaps are not very closely related within the genus. They are easily separated by the following contrasts.

1. Stems erect to ascending-erect from the base; calyx lobes shallowly deltate to subtruncate; corolla tubes 3–5 mm; nutlet commissure reaching the apex ..... *Glandularia malpaisana*
1. Stems mostly prostrate or decumbent-ascending; calyx lobes filiform; corolla tubes 5–7 mm; nutlet commissure not reaching the apex ..... *Glandularia pumila* (Rydb.) Umber

Close in morphology to *Glandularia malpaisana* is *G. delticola* of the Rio Grande Valley of southeastern Texas and southward through eastern Mexico to Chiapas. The two are similar in leaf shape and margin, very small flowers, and nutlet morphology (commissure reaching the apex). In addition to the wide geographic disjunction, however, the two differ in various features.

1. Stems erect, consistently stipitate-glandular; midstem leaf blades 30–50(–60) mm; calyx lobes shallowly deltate to subtruncate; corolla tubes 3–5 mm, limbs 4–5 mm in diam; nutlets 2.5–2.8 mm ..... *Glandularia malpaisana*
1. Stems procumbent to ascending, eglandular or very sparsely stipitate-glandular; midstem leaf blades 30–50(–60) mm; calyx lobes filiform; corolla tubes 7–10 mm, limbs 5–7 mm in diam; nutlets 2.1–2.5 mm ..... *Glandularia delticola* (Small ex Perry) Umber

#### ACKNOWLEDGEMENTS

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**TAXONOMY OF *POLYTAENIA* (APIACEAE):  
*P. NUTTALLII* AND *P. TEXANA***

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**ABSTRACT**

The two species of *Polytaenia* appear to be nearly identical in vegetative and floral features, but fruit morphology shows a distinct and unequivocal difference. *Polytaenia texana* is the species in most of Texas and in southern Oklahoma. *Polytaenia nuttallii* is widespread, from Oklahoma, a few counties in northeastern Texas, and Louisiana, north to Minnesota and Michigan (historically), and east to Kentucky, Tennessee, and Alabama. The two species are mapped by county and distinguished by a key, descriptions, and illustrations.

**KEY WORDS:** *Polytaenia nuttallii*, *Polytaenia texana*, Apiaceae

*Polytaenia texana* has been a generally accepted member of the Texas flora since Mathias and Constance treated it at specific rank (first in 1941, then 1945, 1961) and later contributed the treatment of Umbelliferae to the Texas Manual (Mathias & Constance 1970). Coulter and Rose (1900, 1909) had treated it as a variety of *P. nuttallii*. Diggs et al. (1999) included *P. texana* using the species key by Mathias and Constance, and it has been listed in recent Texas floristic summaries (Hatch et al. 1990; Johnston 1990; Jones et al. 1997). Thus the genus *Polytaenia* has comprised the supposedly Texas near-endemic as well as the *P. nuttallii*, which ranges more broadly.

Coulter and Rose and Mathias and Constance also saw the distinction of *Polytaenia texana* mostly in the fruit morphology (Figure 1 shows the distinction as observed by Mathias and Constance). The couplet first provided by Mathias and Constance (and repeated in subsequent publications) is below; geography is from the Texas Manual treatment.

1. Fruit 5–11 mm x 4–7 mm, lateral wings narrower and thicker than the body, oil ducts indistinct, several in the intervals; in sandy soil in the Timber Belt and the Blackland Prairies, from Texas and Louisiana, north to Kentucky, Michigan, and Iowa

***Polytaenia nuttallii***

1. Fruit 9–11 x 6–7 mm, lateral wings broader and thinner than the body, oil ducts distinct, solitary in the intervals, abundant on the Blackland and Coastal prairies and the Edwards Plateau, endemic to Texas

***Polytaenia texana***

In the most extreme affirmation of the distinctiveness of *Polytaenia nuttallii* var. *texana* from typical *P. nuttallii*, St. John (1919) was so impressed by the fruit differences that he raised var. *texana* to specific rank and placed it in the new genus *Phanerothaenia*, (Greek, *phaneros*, visible, evident, *taima*, ribbon, alluding to the oil ducts), distinct from *Polytaenia* (many oil ducts, as evident in *P. nuttallii*).

On the other hand, ambiguity in the identification of *Polytaenia texana* surely has been underlain by lack of specificity regarding its geographic distribution. The most explicit description of its geography has been by BONAP (2012), which maps *P. texana* mostly in central Texas counties, sympatric with the broadly distributed *P. nuttallii*. Inclusion of *P. texana* by Diggs et al. places it in the region of north-central Texas (including a few counties of the Edwards Plateau). The description in the 1970 Manual (as in the couplet above) positions *P. texana* as widely distributed in Texas and sympatric with *P. nuttallii*.

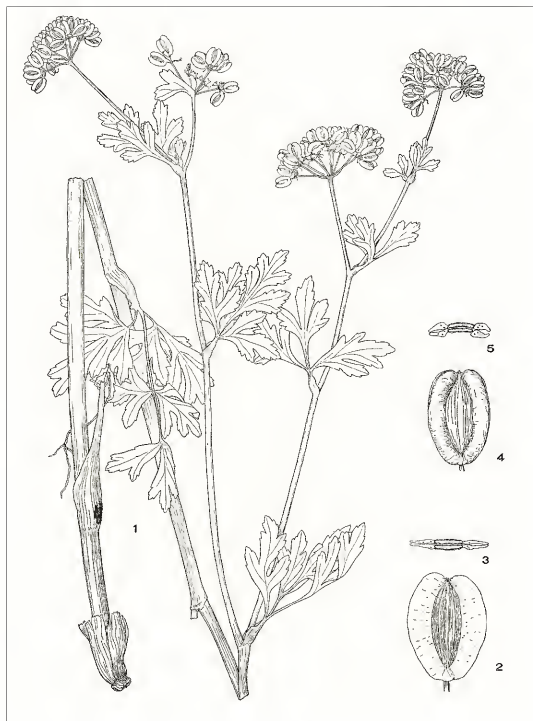


Figure 1. *Polytaenia nuttallii* (1) and representative mericarps *P. texana* (2, 3) and *P. nuttallii* (4, 5). From Mathias and Constance 1961

Outside of Texas, *Polytaenia texana* has been included in the Oklahoma flora on the basis of a collection from Oklahoma Co. (OVPD 2012), in the central part of the state.

The recent Texas Atlas (Turner et al. 2003) mapped only *Polytaenia nuttallii* in Texas, tacitly acknowledging the apparent difficulty of distinguishing the two species there. Turner (pers. comm. 2012) considered *P. texana* to be a synonym of *P. nuttallii*, though it was not listed as such.

The present study confirms the existence of two species of *Polytaenia* and their distinction based on fruit morphology (Figs. 2, 3, 4; key couplet below). Differences between the two species are seen most clearly in fully mature fruits, but the distinctions begin to be evident earlier in maturation. A unequivocal means of distinguishing plants in early flower is not evident, but with the map provided here (Fig. 5), this now will be critical only along the zone where the two are contiguous in range or nearly so. Within the range of *P. texana* in extreme northeastern Texas, fruits of some populations have relatively thickened lateral wings, seemingly approaching the morphology of *P. nuttallii*, but the commissural faces are those of *P. texana* (e.g., Henderson Co., Correll 38924, LL; Smith Co., Cory 56364, SMU).

Molecular studies (Downie et al. 2002; Sun et al. 2004; Sun & Downie 2010a; Sun & Downie 2010b) indicate that the two species of *Polytaenia* ally as a strongly supported monophyletic group with molecular (nucleotide substitution) differences between them. In Downie et al. (2002) the voucher for *P. nuttallii* is from Illinois, but in Sun and Downie (2010a) the voucher for *P. nuttallii* is from Grayson Co., Texas (along the Oklahoma border), and probably represents a population of *P. texana* (see distribution map, Fig. 5). The only voucher for *P. texana* has been from Burnet Co. (in the central part of the state). Thus, in the later study (Sun & Downie 2010a) both samples are almost certainly of the same species.

The difficulty in distinguishing the two taxa in Texas probably has been because two species have been sought where essentially only a single species occurs. The widespread species in Texas and the one most Texas botanists are familiar with is *P. texana*, but it has usually been identified as *P. nuttallii*. True *Polytaenia nuttallii* occurs only in a few northeastern counties and the geographic relationship between the two species (Fig. 5) has previously been undetermined. *Polytaenia texana* also occurs across the southern third of Oklahoma. The distribution of the two species apparently is essentially parapatric.

The Texas and Oklahoma plants, as well as some from Oklahoma, Kansas, and Arkansas (including Nuttall's type, Fig. 6), tend to have wider leaf segments than elsewhere in the range (Fig. 8). Eastern outliers in Alabama often have very narrow segments. There does not appear to be a clear break in the pattern of leaf variation nor is it correlated with the distinction in fruit morphology.



Figure 2. Representative variation in mericarps of *Polytaenia texana*. Dorsal faces. The large fruit at upper left is from a collection from Kaufman Co., Texas (Cory 53280, SMU); the longest fruits on this plant are 15 mm.



Figure 3. Representative variation in mericarps of *Polytaenia nuttallii*. Dorsal faces.





Figure 4. Commissural faces of mericarps. A *Polytaenia texana*. B *Polytaenia nuttallii*.

**POLYTAENIA** DC., Coll. Mém. Ombellif. 5: 53, plate 13. 1829. **TYPE:** *Polytaenia nuttallii* DC.

*Pleiotaenia* Coulter & Rose, Contr. U.S. Natl. Herb. 12: 448. 1909. **TYPE:** *Pleiotaenia nuttallii* (DC.) Coulter & Rose. Coulter and Rose proposed the substitute name for *Polytaenia* because of the slightly earlier *Polytaenium* Desv. (Mem. Soc. Linn. Paris 6: 218. 1827). The current Code, however (ICBN 2006, Article 53.3, Ex. 10) would regard these as "Names not likely to be confused," as did even the 1906 Rules, albeit on a more mechanical basis, as pointed out by St. John (1919).

*Phanerotaenia* H. St. John, Rhodora 21: 182. 1919. **TYPE:** *Phanerotaenia texana* (Coulter & Rose) H. St. John

**Perennial herbs**, without odor, moderately to densely scabrous in the inflorescence with minute, conic, papillate hairs, otherwise glabrous; taproot thickened. **Stems** 5–15 dm. **Leaves:** basal 1–2-pinnately compound, cauline 1-pinnately compound, blades oblong to ovate in outline, 8–18 cm × 8–15 cm, herbaceous and slightly thickened; leaflets 3–5, pinnately to subpinnately divided, lobes ovate or oblanceolate to narrowly oblong, 2–4 cm × 1–2.5 cm, bases rounded to cuneate, sessile to petiolulate, margins coarsely serrate; petioles with dilated sheaths. **Inflorescence:** peduncles terminal and axillary, 1–10 cm; rays 1–2.5(–4) cm, subequal to unequal. **Umbels** compound; umbellets 6–25; involucrel bracts absent or 1 and ca. 1 mm, involucrel bracts linear. **Pedicels** 2–6 mm. **Flowers** protogynous; sepals lanceolate-subulate, persistent; petals yellow to yellow-green or greenish yellow, rarely yellow-orange, apices extended into an appendage half as long as the petal and folded under and adnate to the abaxial surface; stylopodium absent. **Schizocarps** broadly oval to orbicular or obovate, strongly flattened dorsally, 5–11(–15) mm × 4–7 mm, splitting into 2 mericarps, narrowly to broadly corky-winged, wings variable in width and thickness, dorsal ribs 3, oil ducts 3 dorsally, 1 in the intervals, usually 2 or 4 on the commissural face, surface smooth, glabrous; carphophore completely divided the whole length. Base chromosome number,  $x = 11$ .

The closest relatives of *Polytaenia* according to molecular analyses apparently are *Thaspium* and *Zizia* (Sun & Downie 2010a), all of subfamily Apioidae.

1. Mature mericarps with lateral wings distinctly thickened, thicker than the face; oil tubes of dorsal face (6–)8–10, laterally contiguous, covered by epidermis and pericarp and indistinct; oil tubes of commissural face 4, raised and distinct, a contiguous pair on each side of the midrib ..... *Polytaenia nuttallii*
1. Mature mericarps with lateral wings relatively thin, same thickness as the face; oil tubes of dorsal face usually 4, raised and distinct; oil tubes of commissural face 2, raised and distinct, one on each side of the midrib ..... *Polytaenia texana*



1. *Polytaenia nuttallii* DC., Coll. Mém. Ombellif. 5: 54, plate 13. 1829. *Pleiotanea nuttallii* (DC.) Coulter & Rose, Contr. U.S. Natl. Herb. 12: 448. 1909. TYPE: USA. Arkansas. "Arkansa," 1825, *T. Nuttall* s.n. (holotype: G-DC; isotype: PH digital image!). Illustration from de Candolle's protologue, Fig. 7.

Stems 5–10 dm. Leaves: 8–18 cm x 8–15 cm in outline; leaflets 2–4 cm x 1–2.5 cm; petioles 4–16 cm. Inflorescence: rays (10–)20–40 mm. Umbellets (6–)10–25, (6–)12–22(–42)-flowered. Pedicels 2–6 mm. Mature mericarps 6–9 mm x 4–6 mm, dorsal ribs not evident; lateral wings distinctly thickened, thicker than the face; oil tubes of dorsal face (6–)8–10, laterally contiguous (apparently connate at the edges), covered by epidermis and pericarp and indistinct, oil tubes of commissural face 4, raised and distinct, a contiguous pair on each side of the midrib.  $2n = 22$  (Ahles 1974, VDB!, Jefferson Co., Missouri; Bell & Constance 1957).

Flowering Apr–Jun. Blackland prairies, chalk prairies and outcrops, limestone glades, barrens, open rocky woods, rocky hillsides and barrens, rock crevices, sandy pine and pine-oak woodland, roadsides, old fields; 100–300(–900) m; Ala., Ark., Iowa, Ill., Ind., Kan., Ky., La., Mich., Minn., Miss., Mo., Neb., N.Dak., N.Mex., Okla., Tenn., Tex., Wis. *Polytaenia nuttallii* is presumed extirpated in Kentucky (Chester & Wofford 1992), Michigan (Voss 1985), and Minnesota (MDNR 2012). Ecological summaries by states are given by Heikens (2002).

*Polytaenia nuttallii* in Texas. Bowie Co.: just W of New Boston, along pond off Hwy 82, 6 Jun 1965, Correll & Correll 31169 (BRIT); 6 mi W of Hooks, 1.4 mi W of exit Red River Army Depot, sandy clay of clearcut in oak-pine flats by I-30, 4 May 1998, Kral 87550 (VDB); 4.4 mi W of Hooks, open pine-oak woodland, sandy soil, 1 Apr 1949, Whitehouse 21090 (SMU). Harrison Co.: along Hatley Creek, between Red Oak Rd and Shreveport-Camden Rd, ca. 5 mi SE of Hallsville, 14 May 1977, Ajilvsgi 4031 (BRIT); beside I-20, 2 mi E of Farm Rd 2015, 6 May 1967, Weston 66 (VDB).

Both species occur primarily in blackland soil and over limestone substrate but both also grow abundantly in sandy habitats. The sandy habitats of *Polytaenia nuttallii* apparently are mostly in the Texas counties at the southwestern corner of its range.

2. *Polytaenia texana* (Coulter & Rose) Mathias & Constance, Bull. Torrey Bot. Club 68: 123. 1941. *Polytaenia nuttallii* DC. var. *texana* Coulter & Rose, Contr. U.S. Natl. Herb. 7: 192. 1900. *Pleiotanea nuttallii* var. *texana* (Coulter & Rose) Coulter & Rose, Contr. U.S. Natl. Herb. 12: 448. 1909. *Phanerotaenia texana* (Coulter & Rose) H. St. John, Rhodora 21: 182. 1919 (by type but not by description). TYPE: USA. Texas. [Austin Co.]: Near Industry, 1895, *H. Wurzlow* s.n. (holotype: US digital image!).

Stems 5–15 dm. Leaves: 8–18 cm x 8–15 cm in outline; leaflets 2–4 cm x 1–2.5 cm; petioles 4–13 cm. Inflorescence: rays (10–)15–35 mm. Umbellets 8–17, (7–)12–20-flowered. Pedicels 2–6 mm. Mature mericarps 5–11(–15) mm x 4–7 mm, dorsal ribs distinct, 3, thin, orange; lateral wings relatively thin, same thickness as the face; oil tubes of dorsal face usually 4, sometimes 6 (the outer 2 doubled), raised and distinct; oil tubes of commissural face 2, raised and distinct, one on each side of the midrib. Chromosome number not reported.

Flowering Apr–Jun. Blackland prairies, coastal prairies, mesquite prairies, oak-pine woods, sandy oak woods, sandy alluvium along rivers, ditches, rocky hillsides, oak-juniper slopes, roadsides, fencerows, old fields; 10–350 m; Okla., Tex.

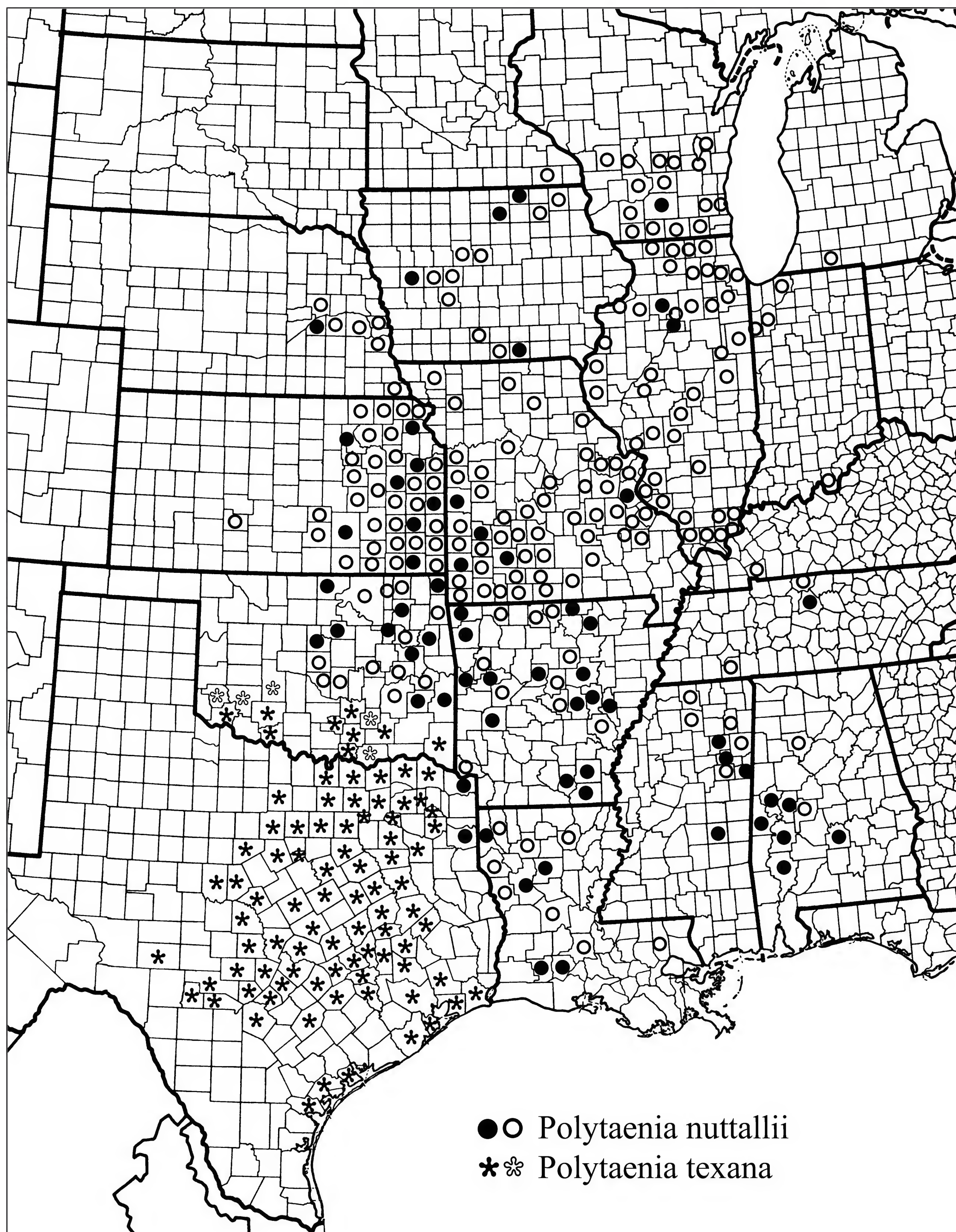


Figure 5. County distribution of *Polytaenia nuttallii* and *P. texana*. Based on records from SMU-BRIT-VDB and TEX-LL. Hollow symbols are from literature, vouchers not seen. Identifications of collections not seen from the Oklahoma zone of parapatry are speculative.



Figure 6 *Polytaenia nuttallii* – isotype collection (PH) by Thomas Nuttall from Arkansas.



Figure 7. *Polytaema nuttallii*. Plate 13 from DC., Coll. Mém. Ombellif. 5. 1829. Detail 7 shows the abaxial view of a petal, with the apex extended into an appendage and sharply folded under. The appendages on a pair of petals clasp an anther and hold it to the outside.





Figure 8. Representative variation in leaf morphology. *Polytaenia nuttallii* (A, B) and *P. texana* (C, D).

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## TAXONOMY OF *EURYTAENIA* (APIACEAE)

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### ABSTRACT

*Eurytaenia* comprises two species, *E. texana* and *E. hinckleyi*, essentially distinguished in morphology only by differences in fruit. *Eurytaenia hinckleyi* is known only from six counties in southwestern Texas and adjacent New Mexico, while *E. texana* is more widespread in Texas and western Oklahoma. A key, descriptions, distribution map, and illustrations of fruits and plants are provided.

**KEY WORDS:** *Eurytaenia texana*, *Eurytaenia hinckleyi*, Apiaceae, fruit morphology

*Eurytaenia* has interesting features of morphology and geography. Observations of a taxonomic study of *Eurytaenia* are put on record here in a synopsis of the genus.

*EURYTAENIA* Torrey & A. Gray, Fl. N. Amer. 1: 633. 1840. **TYPE:** *Eurytaenia texana* Torrey & A. Gray

**Annual herbs**, aromatic with parsley odor; slender-taprooted. **Stems** 3–12 dm, simple or branching mostly from the base, scabrous-papillate in the inflorescence or completely glabrous or glabrate. **Leaves:** basal 1-pinnate, segments lanceolate to ovate-lanceolate with coarsely serrate margins, cauline 2-pinnate (–3-pinnate) blades ovate in outline, ultimate segments linear to filiform with entire margins; glabrous. **Peduncles** terminal and lateral. **Umbels** once-compound; involucre bracts 3-cleft; involucre bracts entire or 3-cleft, distinctly scarious-margined toward the base. **Flowers:** peripheral and central similar, protandrous; sepals distinct, linear to triangular; petals white, margins entire, apex inflexed; stylopodium depressed-conic, nearly flat. **Schizocarps** splitting, ellipsoid or oblong-ellipsoid to broadly ellipsoid or suborbicular, strongly flattened laterally, dorsal ribs 3, filiform, lateral wings thickened and abruptly or gradually thinning, oil tubes large and flattened, solitary in the intervals, 2 on the commissural face, mericarp dorsal surfaces usually scabrous-papillate; carpophore divided completely to the base along the whole length.  $x = 7$ . **Derivation of name:** Greek, *eury*, wide, *tamia*, ribbon or band, alluding to the broad oil tubes, especially those on the commissural faces of *E. texana* mericarps.

In addition to the annual duration and distinctive fruit morphology (Figs. 1, 2), plants of *Eurytaenia* can easily be recognized by their leaf morphology (Figs. 4, 5). The basal are once-compound with the segments lanceolate to ovate-lanceolate and coarsely serrate margined. The cauline become 2(–3)-pinnate and the segments much narrower with entire margins, the medial and distal with filiform to linear segments. All leaves are usually persistent and the transition in morphology usually is evident on a single plant.

As surely did Coulter & Rose, Mathias, and Constance, I searched for any other feature outside of mature fruit morphology that would distinguish the two species but found none. *Eurytaenia hinckleyi* is distinct in its mature mericarps that are relatively narrower in shape with relatively narrower bodies, thickened lateral wings, and a thin dermal covering over the dorsal oil tubes; the commissural oil tubes are narrower, differently shaped, and sparsely papillate (Fig. 1). The difference between the two species is remarkably parallel to the difference between *Polytaenia texana* and *P. mutallii* (Nesom 2012).



Although the mericarp differences show only relatively late in ontogeny, it often is possible to see the developing distinction soon after anthesis. In *Eurytaenia texana* development of the lateral wings is simultaneous at all points from the base to apex. In *Eurytaenia hinckleyi* the thickening begins at the apex (at the mericarp shoulders) and proceeds basipetally.



Figure 1. Mericarps of *Eurytaenia hinckleyi* (A) and *E. texana* (B), dorsal and commissural faces.



Figure 2. Umbellule of schizocarps of *Eurytaenia hinckleyi*. From MO isotype.

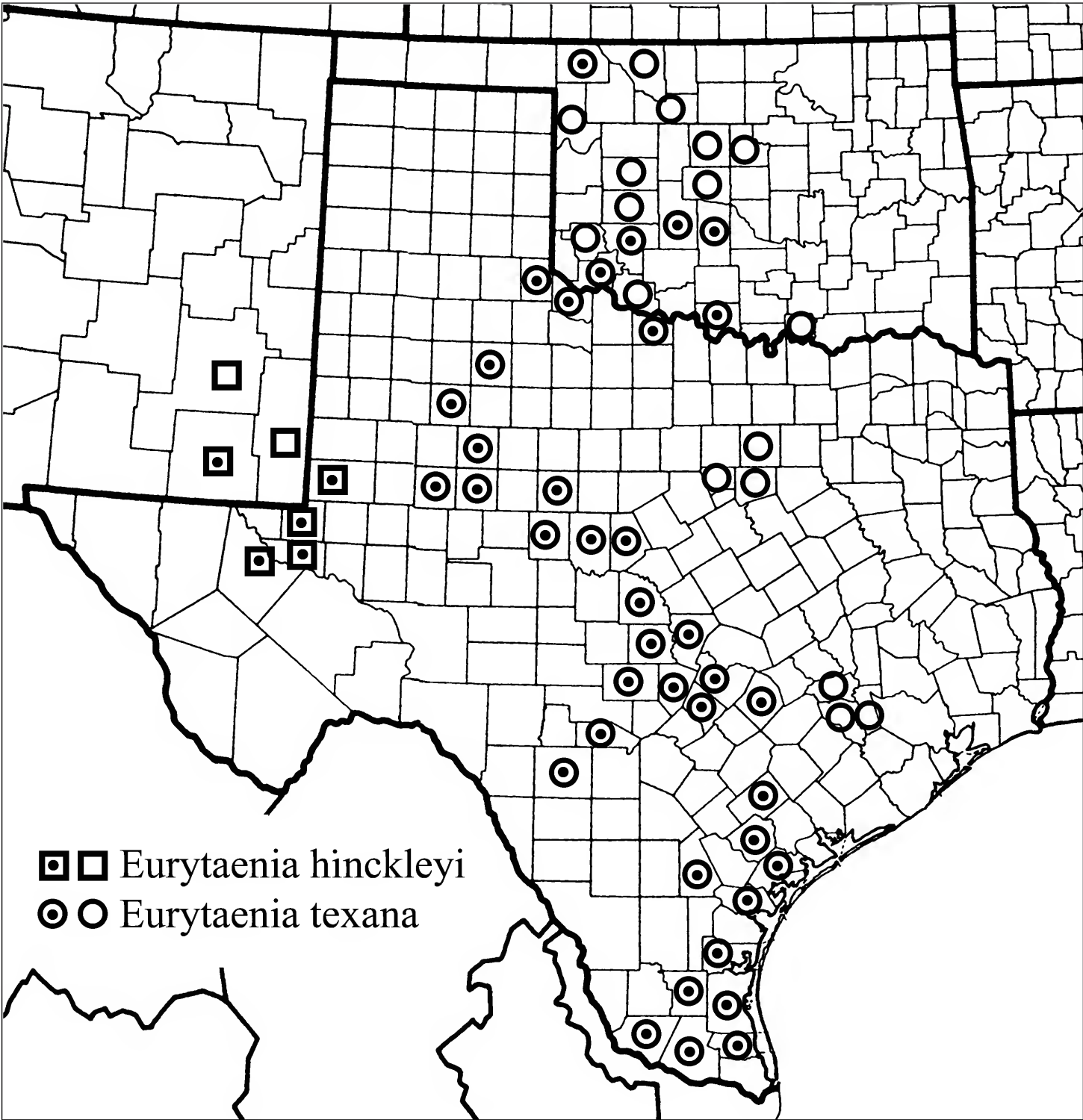


Figure 3. Geographic distribution of *Eurytaenia hinckleyi* and *E. texana*. Symbols without inner dots are from literature records, vouchers not seen. See text (*E. texana*) for documentation of the counties in the two isolated clusters.

- 1. Mericarps broadly elliptic to suborbicular, thickened near the body but becoming thinner than the body toward the margins; oil tubes not covered by pericarp or epidermis, those of commissural face completely glabrous, depressed semi-circular in outline ..... ***Eurytaenia texana***
- 1. Mericarps ellipsoid to oblong-ellipsoid, thickened to the abruptly narrowed-rounded margins, thicker than the body; oil tubes of both surfaces lightly covered by pericarp or epidermis and papillate, those of commissural face narrowly lenticular in outline ..... ***Eurytaenia hinckleyi***



Figure 4. Representative plant of *Eurytaenia texama*. Garza County, Texas.





Figure 5. Representative plant of *Eurytaenia hinckleyi*. Ward County, Texas.

1. *Eurytaenia texana* Torrey & A. Gray, Fl. N. Amer. 1: 633. 1840. TYPE: USA. Texas. Austin Co.: San Felipe, 1835, *T. Drummond s.n.* (holotype: GH).

*Eurytaenia macrophylla* Buckley, Proc. Acad. Nat. Sci. Philadelphia 13: 455. 1861. TYPE: USA. Texas. Washington Co.: no other collection data, ["*Dr. Linsecom*" fide protologue] *Linsecum s.n.* (holotype: PH).

Leaves: blades 4–10 cm x 2–5 cm, lobed or pinnatifid with obtuse, crenate, to serrate lobes, petioles 2–5 cm, cauline pinnately or 3-pinnately dissected, divisions oblong-lanceolate to linear or filiform, margins sharply serrate to entire, terminal often elongate. Peduncles 4–15 cm. Umbels: involucre of ca. 5 usually 3-cleft bracts 5–10 mm; umbellules 10–26, rays 20–80 mm, strongly unequal; flowers 10–22 per umbellule. Pedicels 4–8 mm. Mericarps broadly elliptic to suborbicular, 4–6 mm x 4–5 mm, scabrous-papillate dorsally, glabrous on the commissure, lateral wings often purplish, thickened near the body but becoming thinner than the body toward the margins; oil tubes not covered by pericarp or epidermis, dorsal usually papillate, commissural completely glabrous, those of commissural face depressed semi-circular in outline.  $2n = 14$  (Bell & Constance 1957).

Flowering (Mar–)Apr–Jul(–Aug). Sand and sandy loam, loose alluvial sand over granite, dune-like deposits, abandoned fields, pastures, roadsides, sandy prairies, mesquite savannas, floodplains, oak-juniper woodlands, live oak-pine woodlands; (20–)50–900 m; Oklahoma, Texas.

There appears to be a hiatus in distribution of *Eurytaenia texana* between populations of the Coastal Bend area and those of central Texas and western Oklahoma (Fig. 2), and the habitats are generally different between the two areas. No differences in morphology are apparent, however, and all plants are identified as *E. texana*.

Documentation for the seeming disjunct cluster of three eastern counties is by the types of *Eurytaenia texana* (Austin Co.), *E. macrophylla* (Washington Co.), and a citation by Coulter and Rose (1900) — *Hall 256* from Waller Co. (the specimen presumably at US). Records for Hood and Tarrant counties also are documented by citations from Coulter and Rose (1900) — Reverchon in June 1882 and Reverchon in June 1879, respectively.

2. *Eurytaenia hinckleyi* Mathias & Constance, Contr. Texas Res. Found., Bot. Stud. 1: 2. 1950. TYPE: USA. Texas. Andrews Co.: Shafter Lake, 10 Jul 1941, *B.C. Tharp s.n.* (holotype: MO digital image!; isotype: SMU!).

Leaves: blades 4–10 cm x 2–5 cm, lobed or pinnatifid with obtuse, crenate, to serrate lobes, petioles 2–5 cm, cauline pinnately or 3-pinnately dissected, divisions oblong-lanceolate to linear or filiform, margins sharply serrate to entire, terminal often elongate. Peduncles 4–15 cm. Umbels: involucral bracts ca. 5, 5–10 mm; umbellules 4–14, rays 12–45 mm, strongly unequal; flowers (4–)8–22 per umbellule. Pedicels 3–4 mm. Mericarps ellipsoid to oblong-ellipsoid, 5–8 mm x 4–5 mm, scabrous-papillate dorsally, mostly glabrous on the commissure, lateral wings not purplish, thickened to the abruptly narrowed-rounded margins, thicker than the body; oil tubes of both surfaces lightly covered by pericarp or epidermis and papillate, those of commissural face narrowly lenticular in outline.  $2n = 14$  (Bell & Constance 1957).

Flowering May–Jun(–Jul). Loose sand, sandy soil, dunes, openings in sandy mesquite woodland, sandy roadsides, less commonly gravelly soil of limestone hills; 800–1000 m; New Mexico (Chaves, Eddy, and Lea cos.), Texas (Andrews, Reeves, Ward, and Winkler cos.)

All collections of *Eurytaenia hinckleyi* except one have been made from habitats of loose sand — the record from Reeves Co. seems anomalous in habitat but it perhaps demonstrates an

ecological breadth analogous to that of *E. texana*, as noted above. Reeves Co.: near Pecos, abundant in gravelly soil of limestone hills, 1 Jun 1932, *Whitehouse 8371* (SMU).

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**CASTILLEJA AMBIGUA VAR. MEADII (OROBANCHACEAE):  
A NEW VARIETY FROM NAPA COUNTY, CALIFORNIA**

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**ABSTRACT**

*Castilleja ambigua* var. *meadii* is described from Napa County, California. It is included within *Castilleja ambigua* based on the strong resemblance of the morphology, coloration, and markings of the corollas, as well as the coloration of the bracts. It is distinguished from the other named varieties of *C. ambigua* by its erect, typically unbranched stems and by its linear, often unlobed leaves and bracts with linear lobes. The new variety occurs in low relief, fresh water, vernal wet meadow associations on volcanically derived substrates. The new variety is an uncommon, very localized endemic whose conservation status is in need of prompt evaluation.

**KEY WORDS:** Orobanchaceae, Castillejinae, *Castilleja ambigua* var. *meadii*, new species, endangered species, chromosome numbers, Napa County, California

In 1986, Ruygt first encountered an unfamiliar annual *Castilleja* near Atlas Peak Road, northeast of the city of Napa, California, while conducting an inventory of native plants for a private landowner. The landowner previously recognized the unique character of the natural landscape in the Atlas Peak area and contacted Ruygt to find out more about the diverse selection of species on the property. A search of a small wetland complex on this property brought to light species not previously known to occur in Napa County, including the federally listed species *Navarretia leucocephala* Benth. subsp. *pauciflora* (H. Mason) Day, as well as the novelty described here. In 1987, Ruygt visited the original Atlas Peak site with L.R. Heckard (UC/JEPS). This site contains a seasonally wet meadow, a few small vernal pools, and upland grasslands. Heckard, an authority on the Castillejinae, tentatively identified the new form as *Orthocarpus lacerus* Benth., a species now known as *Castilleja lacera* (Benth.) Chuang & Heckard. Heckard deposited a voucher collection (Heckard & Ruygt 6661) at JEPS, which was apparently recently annotated as a genetic cross “between *C. attenuata* (A. Gray) Chuang & Heckard and *C. rubicundula* (Jeps.) Chuang & Heckard subsp. *lithospermoides* (Benth.) Chuang & Heckard, of hybrid parentage.” No rationale was included with this annotation to justify the hybrid determination. Two additional populations of the new *Castilleja* were discovered in wetlands on the nearby Mead Ranch in 1990.

While working on a manuscript for a new flora for Napa County (in prep.), Ruygt decided to more closely compare the similarities of plant specimens of the putative disjunct populations of *Castilleja lacera* from Napa and Marin Counties with herbarium specimens from populations within the primary range of the species. This study revealed that the Marin County (*Esau s.n.*, UCJ) and Napa County (*Esau s.n.*, JEPS, UCR) specimens were misidentified *Castilleja rubicundula* var. *lithospermoides* and that specimens of *C. lacera* from the main part of its range differed markedly in a number of characters from the Napa County novelty. This information prompted a field investigation, and in 2009 Ruygt visited a population of *Castilleja lacera* in McArthur-Burney Falls State Park, Shasta County, California. Photographs were taken along with a specimen collection (Ruygt 5420a, JEPS) for purposes of comparison in a “green” state of that species with the Napa County plants. This comparison convinced Ruygt that the Atlas Peak populations did not compare well morphologically with typical *C. lacera* and that they did not pertain to that species. In addition, the morphological uniformity of the Atlas Peak populations suggested that recent or current hybridization was not at play in this case.

After some futile attempts by Ruygt to obtain a satisfactory identification of the Atlas Peak populations based on studies at local herbaria, a photograph of a live plant taken by a participant on a California Native Plant Society wildflower hike on the Mead Ranch passed through e-mail channels, eventually connecting Ruygt with Egger in 2010. Egger recognized the unique features of the plants in question, and, after studying close-up digital images and a voucher collection (Ruygt 5575, JEPS, WTU) supplied by Ruygt, he also became convinced that the Atlas Peak populations represented an undescribed form of *Castilleja ambigua* Hook. & Arn. In May 2011, Egger and Ruygt visited two populations of *C. ambigua* var. *meadii*, including the type locality, confirming Egger's preliminary determination of the new variety, as described below.

**CASTILLEJA AMBIGUA** Hook. & Arn. var. **MEADII** J.M. Egger & J.A. Ruygt, var. nov. Figures 1, 3-7. **TYPE:** USA, California. Napa Co.: Mead Ranch, west of Atlas Peak Road, 2.4 km SW of Foss Valley, E 564639, N4250064, vernal pools in rocky meadow in shallow clay soil, with *Eryngium*, *Eleocharis*, on volcanic (Sonoma Formation) substrate surrounded by chamise-*Ceanothus*-oak chaparral, elevation 475 m, 28 May 2011, J. Ruygt 5793 (holotype: WTU; isotypes: CAS, GH, MO, NY, US).

Similar to typical *Castilleja ambigua* Hook. & Arn. in the morphology, coloration, and markings of the corollas as well as the coloration of the bracts but differing from it in its erect, typically unbranched stems, its linear, often unlobed leaves, and its bracts with linear lobes. The new variety also differs in its preference for low relief, fresh water, and vernal wet meadow habitat on shallow, gravelly, volcanically derived substrates.

**Plants** annual, 6–22 cm tall, with thin, fibrous roots. **Stems** unbranched or less commonly with a few divaricate-ascending branches from the proximal half of the stem but above the base, purplish-brown, sparsely pilosulous with mix of shorter, stipitate-glandular hairs and longer, non-glandular hairs, both becoming longer, more often glandular, and more numerous distally, approaching the inflorescence. **Leaves** 1–5 cm long, linear, < 1 mm wide at the base, entire or with 1 (2) pairs of linear lobes, 2–8 mm long; pilosulous to hispidulous and often stipitate-glandular, especially abaxially. **Inflorescences** 1.5–6.0 cm long, with few to many, densely ranked, sessile to short-pedicellate flowers. **Bracts** 5–15 mm long, divided from near the base into 3–5 divaricate-ascending lobes, the central lobe linear to very narrowly linear-lanceolate, the lateral lobes linear; pilosulous to hispidulous and often stipulate-glandular; pale greenish proximally, often with a darker midvein, distal tips pale white, becoming greenish with age. **Calyces** 8–14 mm long, divided subequally into four linear lobes, each 5–9 mm long; pilosulous to hispidulous and stipitate-glandular, pale greenish proximally, often becoming pale yellowish distally. **Corollas** pale yellow, 14–21 mm



long, lower lip 3–4 mm wide, with three divergent, saccate pouches 2–2.5 mm wide, each with a dark reddish-purple spot near the tip at the base of the short, whitish, distal tooth, and often with a similar spot located near the base of each pouch; beaks 1–4 mm long, pale, densely puberulent. **Stigmas** exerted, ca. 2 mm wide, obscurely bilobed, stramineous when receptive, becoming darker with age. **Anthers** 0.8 mm long, exerted at full anthesis. **Capsules** 5–6 mm long, ovoid with a curved, acuminate tip, glabrous, stramineous. **Seeds** many, ca. 0.8 mm long, short-ovoid, brownish; coat tight-fitting, reticulate, cells mostly polygonal-ovate, radial walls moderately deep and horizontally striated, inner tangential walls membranous and apparently unruptured at maturity. **Chromosome number:**  $n = 12$ , based on counts made by Tank from the type gathering, Ruygt 5793 (Fig. 8).

Four of the five known populations of *Castilleja ambigua* var. *meadii* occur on the Mead Ranch and are protected under a Conservation Easement with the Land Trust of Napa County. The Mead Family has set aside 1100 acres as “Forever Wild,” and it is in recognition of the exemplary land conservation ethic of this family that the new variety is named.

**Additional specimens examined.** **USA. California.** Napa Co.: **Population 1** (type locality): Giles Mead Ranch, 8.8 km E of Yountville, large meadow surrounded by Live Oak Woodland/Chamise-*Ceanothus* Chaparral, 0.85 km WNW of main residence, 21 Apr 1990, Ruygt 2489 (JEPS); Atlas Peak Road, S of Foss Valley, Yountville Quad. (7.5'), 6N 4W, S2, SE 1/4 of NE 1/4, 31 May 2010, Ruygt 5575 (JEPS, WTU, tissue sampled for DNA sequencing by D. Tank, ID), 15 May 2011, Egger 1468 (WTU). **Population 2:** Giles Mead Ranch, surrounded by Live Oak Woodland, ca. 0.3 km NW of main residence, live plants examined by Ruygt but population unvouchered and now apparently extirpated. **Population 3:** Giles Mead Ranch, surrounded by Live Oak Woodland, ca. 0.4 km W of main residence, live plants examined by Ruygt but unvouchered. **Population 4:** Giles Mead Ranch, surrounded by Black Oak Woodland, ca. 0.7 km NE of main residence, 28 May 2011, Ruygt 5796 (JEPS). **Population 5:** 4.5 mi N of Westgate Dr. on Atlas Peak Rd., upper end of Milliken Canyon, 18 May 1986, Ruygt 1777 (JEPS); 6.5 mi up Atlas Peak Rd. from Monticello Rd., 10 May 1987, Heckard & Ruygt 6661 (JEPS).

### Distribution and range

All populations of var. *meadii* occur within a highly localized district of the Atlas Peak plateau on a single site type characterized by very gradual slopes, shallow clay soils of volcanic origin, and numerous surface rock outcrops (rubble). Populations are known from 5 locations (Fig. 2), four that occur on the Mead Ranch, a 1300-acre property, largely under conservation easement with the Land Trust of Napa County (LTNC). One population on the Mead Ranch is now apparently extirpated, probably due to competitive pressure from invasive weed species including perennial grasses. The fifth population is partially protected by a conservation easement between a past landowner and the LTNC and now honored by the present owner. Additional populations may occur nearby on adjacent properties and in the Howell Mountain area to the northwest.

### Phenology, ecology, and associated species

*Castilleja ambigua* var. *meadii* flowers from April through June in seasonally wet meadows, shallow vernal pools, and along the margins of ephemeral streams. The elevation of the known populations ranges between 450–475 m. The meadows in which this variety is found are typically small (< 10 acres) and surrounded by chamise-*Ceanothus* chaparral, mixed oak-foothill pine woodland, or black oak forest. It occurs in thin clay soils of the Aiken Series (Lambert & Kashiwagi, 1978), of volcanic origin. The bedrock is basic, of the Sonoma Volcanic Formation (< 5 million y.o.). Some sites are seasonally inundated and are classified as Northern Basalt Flow Vernal Pools, a Department of Fish and Game designated rare plant community (Holland 1986). Common associate species include *Eleocharis macrostachya* Britton, *Eryngium aristulatum* Jeps. var. *aristulatum*, *Holozonia filipes* (Hook. & Arn.) Greene, *Allium amplexans* Torr., *Downingia concolor* Greene, and

*Isoetes* spp. This is a diverse wetland community, including over 25 vascular plant species documented as near neighbors to *C. ambigua* var. *meadii*.

In at least one population (the type locality), *Castilleja attenuata* is a common associate of the new variety, often growing within centimeters of it. No evidence of any kind of hybridization or genetic introgression between these closely related annual *Castilleja* forms has been observed. The same is also true of *Castilleja densiflora* (Benth.) Chuang and Heckard, which occurs around the drier margins of some populations of *C. ambigua* var. *meadii*.

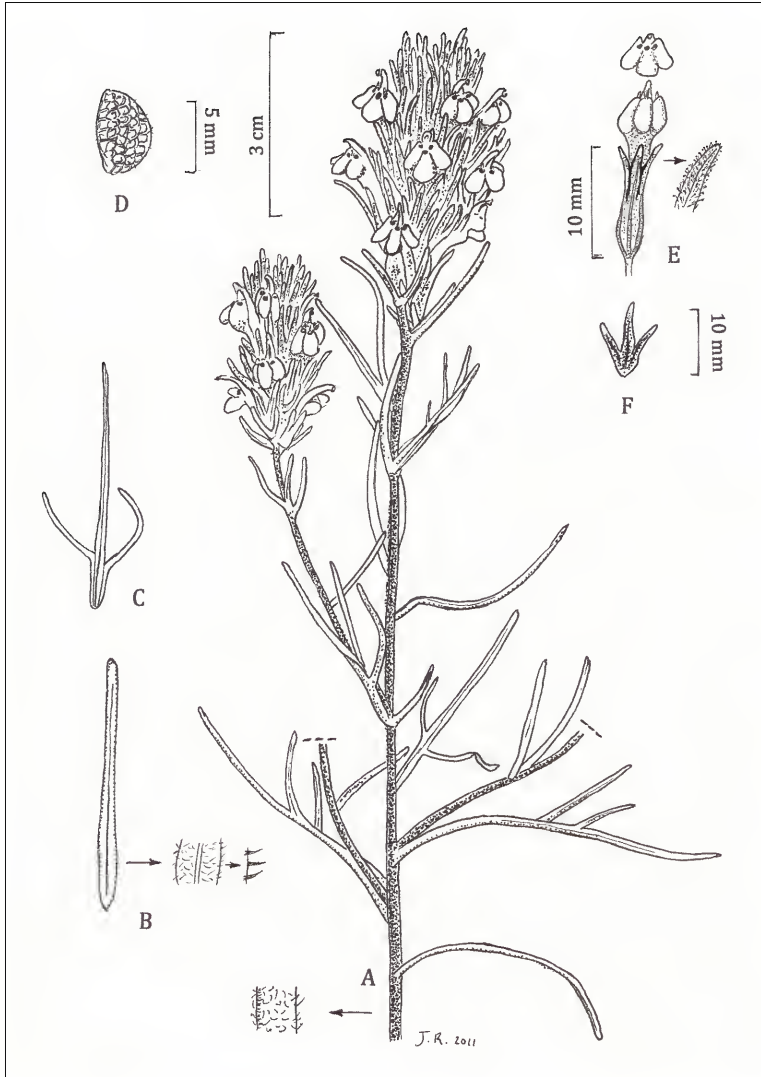


Figure 1. *Castilleja ambigua* var. *meadii* J.M. Egger & J.A. Ruygt. A. Habit with proximal stem pubescence detail and inflorescences. B. Proximal leaf with pubescence detail. C. Distal leaf. D. Seed coat. E. Calyx and corolla with calyx pubescence detail. F. Floral bract. Illustration by J. A. Ruygt.

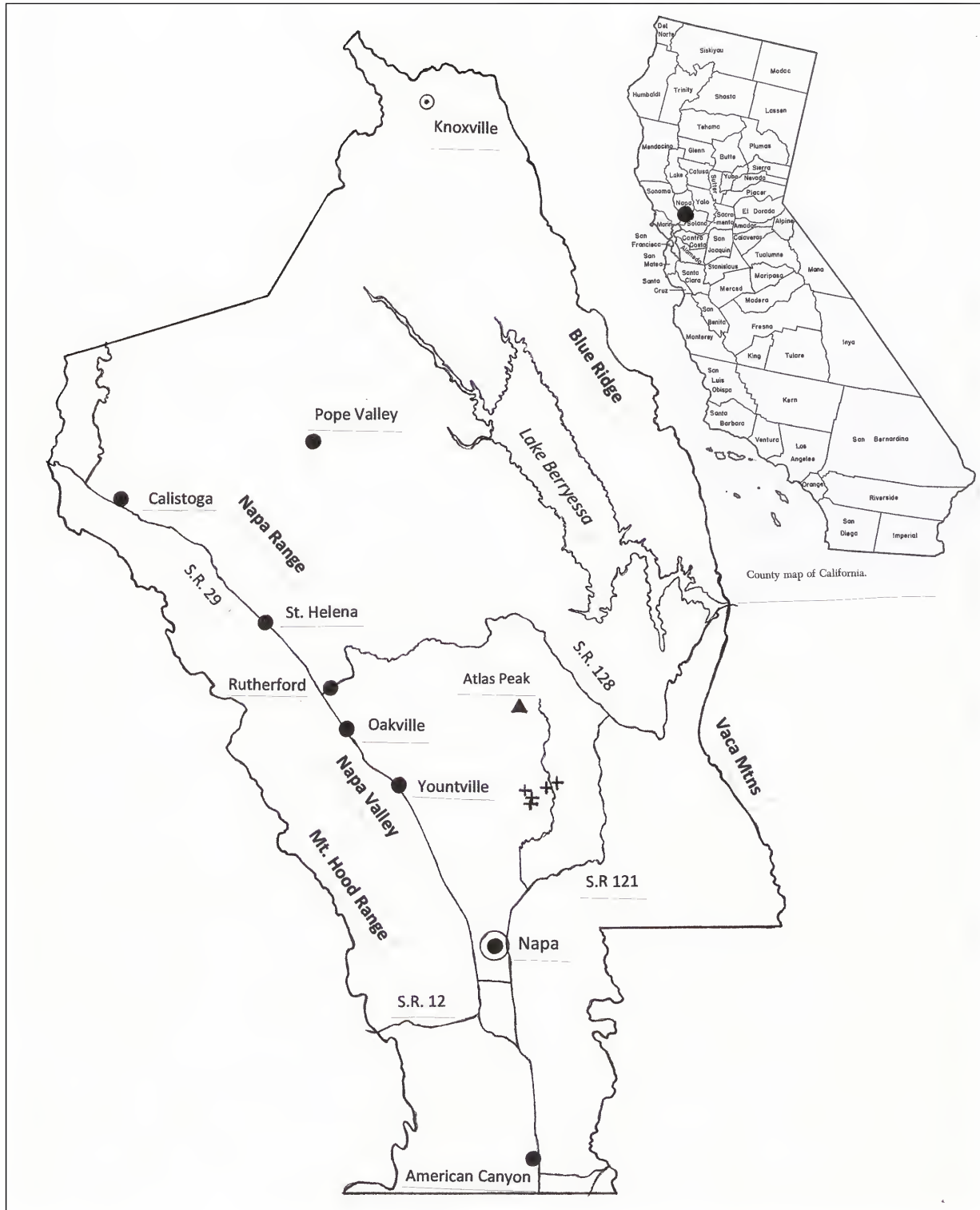


Figure 2. Range of *Castilleja ambigua* var. *meadii* within California and within Napa County. Populations of the new variety are indicated by + symbols on the Napa County map.



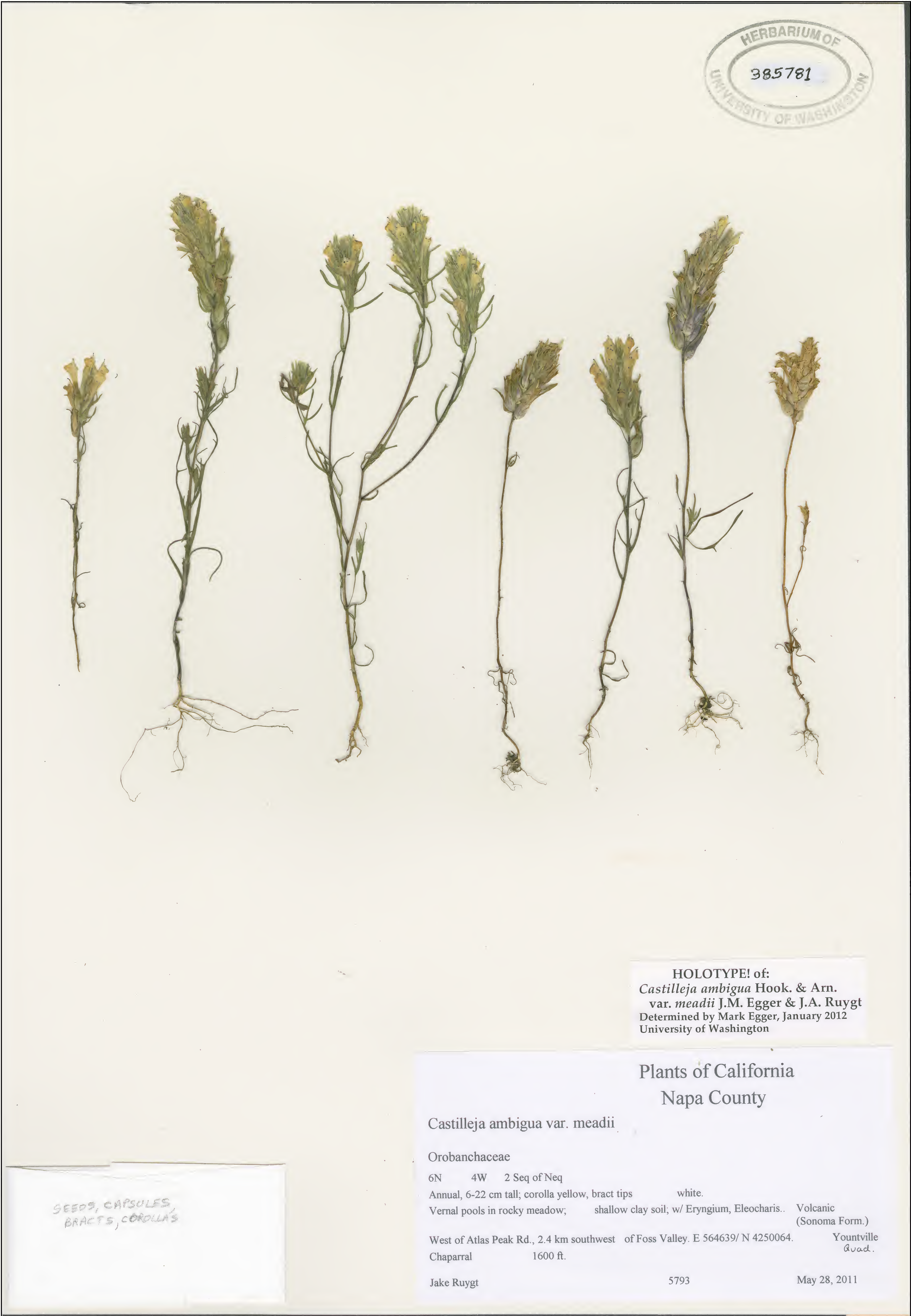


Figure 3. Holotype collection of *Castilleja ambigua* var. *meadii* (Ruygt 5793, WTU).





Figure 4. *Castilleja ambigua* var. *meadii*, cluster of plants in habitat. Photo by Mark Egger.



Figures 5-6. *Castilleja ambigua* var. *meadii*, inflorescence (L) and whole plant (R). Photos by Mark Egger.



Figure 7. *Castilleja ambigua* var. *meadii*, inflorescences and upper stem. Photo by Mark Egger.

**Methods for chromosome counts.** Immature floral buds were fixed in Carnoy's solution (3 part 100% EtOH: 1 part glacial acetic acid v/v; Chuang & Heckard 1993). Anther sacs were dissected from floral buds ca. 1.6–2.0 mm long and stained with aceto-carmin on a microscope slide. Microspore mother cells were released from the anthers, anther walls were removed, a glass coverslip was added, and the slide was then gently heated to just before boiling. To insure accuracy, chromosomes were counted from approximately 12 cells using 100x magnification on a Zeiss phase contrast microscope.

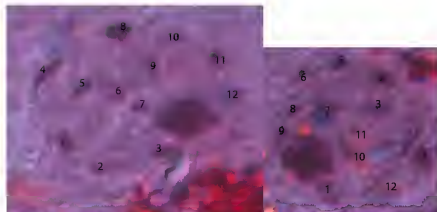


Figure 8. Photographs of two pollen mother cells of *Castilleja ambigua* var. *meadii* from Ruygt 5793 showing numbered chromosome locations. Photos by David Tank.

### Relationships and identification

*Castilleja ambigua* is a complex and polymorphic species endemic to the west coast region of North America, from southern California north to extreme southwestern British Columbia, Canada. It was previously placed in the formerly paraphyletic genus *Orthocarpus* Nutt. as *O. castillejoide*s Benth. Jepson (1925) described *O. castillejoide*s var. *insalutatus* Jeps., and Keck (1927, in his revision of *Orthocarpus*) added another infraspecific segregate, *O. castillejoide*s var. *humboldtensis* D.D. Keck. Later, *O. castillejoide*s and the other species of the former *Orthocarpus* sect. *Castillejoide*s A. Gray and sect. *Cordylanthoide*s Keck were moved into *Castilleja* in Chuang and Heckard's revision of the *Castillejinae* (Chuang & Heckard 1991). At that time, Chuang and Heckard adopted the previously published name, *C. ambigua* Hook. & Arn. for *O. castillejoide*s and changed the rank of the infraspecific groupings from variety to subspecies. Subsequently, Egger (2008) reestablished the use of varieties for the infraspecific categories within *C. ambigua*, as part of a broader attempt to provide a standardized nomenclature with the entire genus.

*Castilleja ambigua* var. *humboldtensis* (D.D. Keck) J.M. Egger and *C. ambigua* var. *insalutata* (Jeps.) J.M. Egger are both strictly coastal, occurring in estuarine salt marshes and on sandy dunes and bluffs. The typical form of *C. ambigua* is more adaptable and far more widespread, occurring in a number of complex and variable forms both along the coast and somewhat sporadically in grasslands and meadow situations some miles in from the immediate coast.

We place the new variety within *Castilleja ambigua* due primarily to the morphology, coloration, and markings of the corollas, which are virtually identical to those found in many individuals of the nominate variety, as well as the whitish tips on the distal portion of the bracts. Indeed, the corollas of var. *meadii* could likely be exchanged with those of the typical variety without being noticed, even under magnification. Points of congruity include: pale yellow background coloration, a single reddish-purple marking at the base of each distal tooth of the each lobe of the lower lip of corollas, and, in many plants, a similar set of markings near the base of each inflated sac of the lower lip of the corolla. However, var. *meadii* is immediately and with ease separated from the other forms of *C. ambigua* by the characters noted in the key below, and the somewhat wispy plants are quite distinctive in the field (Fig. 9). It should also be noted that populations of the typical inland form of the nominate variety of *Castilleja ambigua* occur in the Foss Valley (Ruygt 4432), ca. 3 km



northwest of the nearest population of var. *meadii*, with no signs of intergradation between the two entities.

Phylogenetic research now underway at the University of Idaho will eventually clarify the relationships between *Castilleja ambigua* var. *meadii* and the other varieties of *C. ambigua*, as well as its placement within the genus as a whole.



Figure 9. The named varieties of *Castilleja ambigua* in the field. From left to right, var. *meadii*, var. *ambigua*, var. *humboldtiensis*, and var. *insalutata*. Photos by Mark Egger.

As noted above, an annotation of the collection *Heckard and Ruygt 6661* (JEPS) proposes that the new variety is of hybrid origin between *Castilleja attenuata* and *C. rubicundula* var. *lithospermoides*. While such a conjecture is not unreasonable based on a presumed intermediate morphology between these two species, there is little evidence to support this concept in the field. While this combination might reasonably apply to an  $F_1$  hybrid between the two putative parent species, the populations of *C. ambigua* var. *meadii* are all quite uniform in morphology and show none of the wide variation of characters in typical hybrid swarms found regularly in *Castilleja* (Egger 1994 and unpubl. data). In fact, the plants both within and between the populations of var. *meadii* are more uniform in morphology than are those of many other widely accepted species within the genus.

Moreover, the meiotic chromosome number of  $n = 12$  presented here is the base number for *Castilleja* (Chuang and Heckard 1991), indicating that the new variety is clearly not of allopolyploid hybrid origin. Both *C. ambigua* var. *ambigua* (Atsatt 1966; Chuang and Heckard 1982) and var. *humboldtiensis* (Anderson 1965) are also known only from counts of  $n = 12$ . While a homoploid hybrid origin for the new variety cannot be conclusively ruled out at this time, such a scenario seems unlikely, due to the lack of significant variation within and between the different populations. DNA analysis now underway by Tank should resolve the details of the relationships of var. *meadii* in the near future.



A simplified key for separating *Castilleja ambigua* var. *meadii* from other annual species of *Castilleja* occurring from the San Francisco Bay Region northward in California.

1. Bracts distally colored red to very occasionally yellow, lower lip of corollas rudimentary, greenish or reddish and not at all inflated ..... *C. minor*
1. Bracts distally colored rarely if ever as above, lower lip of corollas petaloid and slightly to strongly pouched.
  2. Bracts colored uniformly greenish throughout ..... *C. lacera*, *C. rubicundula*, *C. tenuis*
  2. Bracts proximally colored dullly and more or less uniformly, but distally colored brightly and contrastingly, at least when emergent.
    3. Bracts distally colored purplish to magenta or pink, rarely white and then mixed into populations of typically colored plants and greatly outnumbered by them ..... *C. densiflora*, *C. exserta*
    3. Bracts distally colored white to rarely pale yellowish.
      4. Inflorescences slender, 10-20 mm wide; corollas more or less linear, the inconspicuous pouches about 2 mm wide; stigmas included within the corolla beaks ..... *C. attenuata*
      4. Inflorescences broadened, 20-40 mm wide; corollas widened distally, the conspicuous pouches usually 3-5 mm wide; mature stigmas usually exerted from the corolla beaks.
        5. Leaves and bracts entire and more or less lanceolate ..... *C. campestris*
        5. Leaves usually divided or less commonly a mixture of divided and undivided leaves, bracts always divided and not as above.
          6. Plants stems more or less decumbent, at least proximally, usually branched, often profusely; lobes of leaves and bracts lanceolate to broadly lanceolate and often distally rounded; plants of various habitats, including coastal salt marshes, the margins of brackish estuaries, coastal sandy bluffs, and mesic to somewhat xeric inland grasslands ..... *C. ambigua*, incl. var. *humboldtensis* and var. *insalutata*
          6. Plants stems upright, usually unbranched, uncommonly with a few ascending branches, lobes of leaves and bracts linear; plants of gravelly, vernal moist, inland meadows in volcanically derived soils ..... *C. ambigua* var. *meadii*

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CONTRIBUTIONS TOWARD A REVISION OF *HECHTIA*  
(BROMELIACEAE, PITCAIRNIOIDEAE)

II. NEW AND NOTEWORTHY *HECHTIA* SPECIES FROM OAXACA, MÉXICO

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ABSTRACT

Three new *Hechtia* species from Oaxaca, México are described, discussed, and illustrated: *H. complanata* Burt-Utley, *H. xtlanensis* Burt-Utley, and *H. isthmustana* Burt-Utley.

**KEY WORDS.** Bromeliaceae, *Hechtia*, México, Oaxaca

*Hechtia*, a genus of over 60 species, is widely distributed in México, ranging from the northern Mexican states that border the United States to the southernmost state of Chiapas where it borders Guatemala. Although widespread in México, this genus is most abundant in the state of Oaxaca, where at least 21 species are known, including the three described herein. Moreover, all but a few of these species are apparently endemic to Oaxaca and those that have slightly broader distributions occur in adjacent states. The greatest diversity of *Hechtia* in the state occurs in central Oaxaca near and north of the city of Oaxaca and south and southeast to the Isthmus of Tehuantepec. In this typically seasonally dry region with thorn-scrub vegetation and deciduous trees, but pine and oak at higher elevations, there are at least 11 species of *Hechtia* known, including the three species described herein.

**1. HECHTIA IXTLANENSIS** Burt-Utley, sp. nov. **TYPE. MÉXICO.** Oaxaca. 39.6 mi N of MEX 195 E of the city of Oaxaca along MEX 175 to Ixtlán de Juárez and Tuxtepec, 5600 ft, 28 Jul 1987, J. Utley & K. Utley 7961 (holotype: MEXU; isotypes: B, C, CAS, GH, M, MICH, MO, NY, US, USF, XAL). Figures 1, 2, and 3.

**Plants** in flower with rosettes to 8 dm diam and inflorescences 1.5–2.7 dm high. **Leaves** very numerous, spreading to subspreading above the sheath, 39–64 cm long; sheaths hemiorbicular to broadly transversely elliptic, 5–8.5 cm long, 8–12 cm wide, the margins finely spinose and distally floccose, both surfaces glabrous and lustrous becoming densely lepidote distally to half their length, stramineous but oldest bases brunnescens to castaneous distally; blades straight to subfalcate, narrowly triangular, 32–56 cm long and 2–3.5(–4.5) cm wide above the base, terminally spinose, the margins aggressively armed with antrorse to retrorse red-brown spines 1.5–4.5 cm apart and (1.5–)3–6(–8) mm long, above and below typically covered with appressed cinereous scales but occasionally appearing glabrescent. **Inflorescences** terminal, in staminate individuals twice compound or rarely once compound with (0–)5–9(–11) ascending secondary branches, but in pistillate individuals once or rarely twice compound with 0–2 secondary branches, both sexes usually with secondary branches in the lower half to third of primary branches, lepidote; scape similar and stout in both sexes, to 11.8 dm, and 2–3 cm diam at the base, lepidote; internodes short, 0.6–2.7 cm, lepidote; lowermost scape bracts foliaceous, 25–36 cm with short, triangular bases and long linear finely spinose and spinose tipped blades; mid- and upper scape bracts longer than the internodes, ovate-triangular with appressed linear-triangular blades but reflexed with age, 1.5–13.5(–21) cm; rachis 6.6–12.6 dm and 27–41 cm diam; primary bracts 1.5–9.5 cm long, longer than to shorter than the sterile bases of the branches;

primary branches of staminate inflorescences 16–25 cm long, lepidote, the sterile flattened bases (0.3–)1.5–7 cm, secondary branches 0.5–9.5 cm; but in pistillate inflorescences primary branches 6–22 cm long, the sterile flattened bases 0–2.5 cm, lepidote; secondary branches when present 3–6 cm long. **Staminate flowers** very numerous, spreading; floral bracts borne on sulcate ridges of branches, chartaceous, ovate-triangular to broadly ovate, convex, 1.2–3 X 0.8–1.8 mm, finely spinulose-serrulate, lepidote; pedicels articulated with the axis, conical, stout, 0.7–1.8 cm long, glabrous to sparingly lepidote; sepals 3-nerved, ovate-triangular to triangular, 1–1.6 X 0.8–1.8 mm, often conspicuously 3-nerved, cucullate distally, apiculate, marginally even to erose or very finely serrulate, glabrous to sparingly lepidote; petals ovate to elliptic, (2–) 2.5–3.2 X 1.5–2 mm, cucullate distally, apically rounded to praemorse, glabrous, cream-colored; rudimentary ovaries present. **Pistillate flowers** very numerous, sometimes in whorls, ascending; floral bracts borne on sulcate ridges of branches, chartaceous, flat to convex, ovate-triangular, 1.3–2.5 X 1–1.6 mm, proximally irregularly finely serrulate-spinulose, apiculate, glabrous to sparingly lepidote; pedicels stout, 0.5–1.5 mm long, glabrous to lepidote; sepals often conspicuously 1-nerved, ovate-triangular, 1–1.5 X 0.7–1.5, occasionally cucullate distally, apiculate, erose distally, glabrous to lepidote; petals triangular, (1.5–)2–3 X 1–1.5 mm, rounded to acute, glabrous, greenish yellow. **Capsules** with pedicels 1.5–2.8 mm long; bodies ovate-elliptic, 6.5–8 X 2.8–4 mm, smooth but sparingly finely ridged, greenish brown, glossy.

**Distribution and habitat.** *Hechtia xtlanensis* is known only from central Oaxaca, where it has been collected in the Sierra Madre north of the city of Oaxaca at elevations between 5500 to 5600 ft on moist steep forested slopes with *Quercus*, *Pinus*, and low shrubs.

*Hechtia xtlanensis* is a large species with rosettes to 8 dm and leaves to 64 cm long. Its leaves are densely lepidote but appear more conspicuous in some individuals than in others within the type population. *Hechtia xtlanensis* shares a similar rosette and leaf form with *H. pringlei*, which is known from central Oaxaca near the city of Oaxaca. The species differ immediately in inflorescence characters as well as floral characters. Inflorescences of staminate individuals of *H. xtlanensis* are twice compound like those of *H. pringlei*, but differ in their longer primary branches (16–25 cm vs 4–15 cm) and up to 11 secondary branches while staminate inflorescences of *H. pringlei* typically have two or rarely no secondary branches (pers. obs.). Similar differences are observed in the lengths of primary branches of pistillate inflorescences, with those of *H. xtlanensis* generally longer than those of *H. pringlei* (6–22 cm vs 3–9.5 cm). There are also differences in flower color between these species, with petals of staminate flowers of *H. xtlanensis* cream colored while those of *H. pringlei* are very pale yellow. Pistillate petals are greenish yellow in *H. xtlanensis*, but are distinctly green in *H. pringlei*. The sexual dimorphisms observed in both *H. xtlanensis* and *H. pringlei* are relatively common in *Hechtia* and have been observed in other species (Burt-Utley & Utley, 1993; 2011). Since the ovaries are partially inferior in both taxa and the length of the inferior portion cannot be accurately measured on dry specimens, sepal lengths were measured from sepal apices to the middle of their bases, while pedicel length was measured from the rachis of the lateral branches to the middle of the sepal bases.

**Additional specimens examined.** MÉXICO. Oaxaca. 5.8 mi E of Ixtlán de Juárez on new road to Xiacui and ca 34 mi N of city of Oaxaca, 4 Aug 1981, Utley & Utley 6691 (CAS, GH, MEXU, MICH, US, USF).



Figure 1. *Hechtia ixtilanensis*. Isotype of leaves (from Utley & Utley 7961, USF).



Figure 2. *Hechtia ixtilanensis*. Isotype of part of staminate inflorescence (from Utley & Utley 7961, USF).



Figure 3. *Hechtia ixtilanensis*. Isotype of part of pistillate inflorescence (from Utley & Utley 7961, USF).

2. **HECHTIA COMPLANATA** Burt-Utley, sp. nov. TYPE. MÉXICO. Oaxaca. MEX 190 between Totolapan and Las Margaritas, ca 3.2 mi NW of Las Margaritas or 34.8 mi SE of turnoff to Mitla, 3500–3700 ft or 1100 m, 7 Aug 1992, J. Utley & K. Utley 8823 (holotype: MEXU; isotypes: BM, CAS, GH, MICH, MO, US, USF). Figures 4, 5, and 6.

**Plants** solitary, with rosettes 1–1.2 m diam and inflorescences to 2.3 dm high; new individuals developing in leaf axils of parent plant. **Leaves** numerous, subspreading to ascending, 51–79 cm long; sheaths on older leaves hemiorbicular to transversely elliptic, 6–7.5 cm long, 9.5–16 cm wide, marginally finely spinulose and distally floccose, both surfaces glabrous and lustrous becoming densely lepidote distally to a third their length, stramineous to castaneous, but older bases brunneous throughout above and below, but pale castaneous near their margins; blades straight to weakly falcate, narrowly triangular, (45–)51–74 cm long and 2.5–4.5 cm wide about 5–6 cm above the sheath, spinose tipped, the margins armed with antrorse and retrorse, or rarely straight, castaneous to dark brown spines 2.7–5.3 cm apart and (3–)4–7.5 mm long, above and below covered with appressed cinereous scales, but these most conspicuous on the lower third of the blade, blades becoming glabrescent with age, green occasionally flushing pink. **Inflorescences** terminal, in staminate individuals twice compound with 1–14 secondary branches and only rarely thrice compound with one or more secondary branches with very short branchlets, but in pistillate individuals once compound or infrequently twice compound with 1(–2) secondary branches, both sexes usually with secondary branches in the lower half to third of primary branches, lepidote to glabrous; scape in staminate individuals, to 76 + cm high, 1.2–3 cm diam, finely lepidote; in pistillate individuals to 118 X 2.2–3 cm, finely lepidote to glabrous; lowermost scape bracts foliaceous, ascending, 31–33 + cm long, spinose and spinose tipped; the remaining scape bracts ascending, becoming progressively reduced distally and exceeding the short, 0.4–5 cm long, usually minutely lepidote internodes, bracts basally triangular with linear, finely striate spinose and spinose tipped blades, lepidote; primary bracts of staminate inflorescences (1.2–)3–11.5 cm long, those of pistillate inflorescences (1.4–)3–5 cm long, spinulose and spinose tipped, lepidote, shorter than the lateral branches and shorter than to longer than the sterile bases of the branches; lateral branches complanate basally and sometimes throughout, appearing elliptic in cross-section, ascending, striate and sulcate, those of staminate inflorescences (8–)11.5–32 cm long, those of pistillate inflorescences (8.5–) 13–23.5 cm long, subsascending, both densely many-flowered, finely lepidote to apparently glabrous. **Staminate flowers** spreading, occasionally in verticils; floral bracts shorter than to equaling the sepals, chartaceous, flat to navicular, ovate to narrowly triangular, 0.9–2 X 0.3–0.8 mm, finely spinulose-serrulate, attenuate-acuminate, lepidote; pedicels articulated with the rachis, stout, conical, 0.3–1.5 mm long to the center of the base of the sepals, lepidote; sepals somewhat imbricate, subequal, chartaceous, convex and ovate to deltoid, 1.2–1.6 X 1–1.6 mm, cucullate distally, apiculate, occasionally finely serrulate-spinulose or erose especially distally, lepidote; petals spreading, ovate, drying spatulate to elliptic, 2.5–4.5 X 1.3–2.2 mm, apiculate, glabrous, pale yellow. **Pistillate flowers** subsascending, occasionally in verticils; floral bracts chartaceous, convex and triangular, 1–1.5 mm X 0.4–0.7 mm, apiculate, finely serrulate-spinulose, lepidote to occasionally glabrous; pedicels articulated with the rachis, stout, conical, 0.5–1 mm long to the center of the base of the sepals, lepidote to occasionally glabrous; sepals convex, triangular, 0.8–1.2 X 0.8–1.2 mm, to the center of the base of the sepals, praemorse, entire to irregularly finely serrulate, lepidote to occasionally glabrous; petals triangular, 2.1–2.9 X 1–1.8 mm, apiculate to acute, glabrous, green; ovaries lepidote. **Capsules** with stout conical pedicels 1.5–2 mm long; bodies loculicidally and septically dehiscent, cylindric to narrowly elliptic, 7.5–8.5 X 3–4 mm, finely lepidote, when immature dark brown but drying olive green.





Figure 4 *Hechtia complanata*. Isotype of leaves (from J. Utley & K. Utley 5823, USF)



Figure 5. *Hechtia complanata*. Isotype of part of staminate inflorescence (from J. Utley & K. Utley 8823, USF)



Figure 6. *Hechtia complanata*. Isotype of part of pistillate inflorescence (from J. Utley & K. Utley 8823, USF).

**Etymology.** The specific epithet *complanata* refers to the horizontally flattened or subflattened branches of *Hechtia complanata* on the type series. Although it is not uncommon to find species with flat sterile bases of branches, the vast majority of species examined have most of the fertile part of their branches rounded.

**Distribution and habitat.** *Hechtia complanata* is known only from central Oaxaca, where it grows on outcrop slopes with low deciduous forests and thorn-scrub vegetation between 3500 and 4000 ft.

**Discussion.** *Hechtia complanata* is a robust, aggressively spinose species that stands apart from most other *Hechtia* species in its inflorescence branches that are often horizontally complanate for much of their length and in its staminate individuals with frequently very numerous secondary branches. Within the type series, most inflorescences were lepidote, but at least one lacked significant pubescence. *Hechtia complanata* is distinct from other *Hechtia* species with terminal inflorescence in its sparingly lepidote ovaries, since lepidote ovaries have only been consistently observed in species with lateral inflorescences, including *H. glomerata* Zucc. and *H. texensis* S. Watson.

As in many other *Hechtia* species, staminate flowers of *H. complanata* are small, with staminate sepals only 1.2–1.6 X 1–1.6 mm and pistillate sepals 0.8–1.2 X 0.8–1.2 mm. It should be noted that sepal lengths were measured from the sepal apices to the middle of their bases, while pedicel length was measured from the rachis of the lateral branches to the middle of the sepal bases to standardize measurements. *Hechtia complanata* is similar to *H. xtlanensis* in its articulated pedicels, twice compound staminate inflorescences with numerous secondary branches and shorter staminate pedicels, but it differs from *H. xtlanensis* in its often larger leaves [(45–)51–74 cm vs 32–56 cm] and pale yellow staminate petals and green pistillate petals. From *H. pringlei*, the staminate inflorescences of *H. complanata* are immediately distinguished by their longer primary branches [(8–)11.5–32 cm vs. 4.3–15 cm] with numerous secondary branches [1–14 vs. 0 or 2].

**Additional specimens examined.** MÉXICO. Oaxaca. Ca. 60.4 mi NW of Rio Hondo on MEX 190 to Oaxaca, 4000 ft, 1 Jan 1987, *J. Utley & K. Utley* 7691 (MEXU, US, USF).

3. **HECHTIA ISTHMUSIANA** Burt-Utley, sp. nov. TYPE. MÉXICO. Oaxaca. 12.4 km N of La Ventosa junction on MEX 185 (Transisthmian Hwy), 800 ft, 24 May 1990, *J. Utley & K. Utley* 8491 (holotype, MEXU; isotypes, CAS, GH, MO, NY, US, USF, XAL). Figures 7 and 8.

**Plants** caulescent to 0.6–1 m with rosettes 2.5–5 dm diam and inflorescences 3.5–9.4 dm high. **Leaves** several to many, spreading to strongly reflexed, 14–36 cm long; sheaths on oldest leaves often completely encircling the plant base, 2–4 X (2.8–)4–8 cm, marginally finely spinulose and floccose, both surfaces glabrous and lustrous becoming lepidote distally, pale to dark castaneous; blades straight to subfalcate, narrowly triangular, 1.5–2.4 cm wide about 3 cm above the sheath, spinose tipped, marginally armed with generally antrorse spines (0.6–)0.8–1.8 cm apart and (0.5–)1.8–2.5 mm long, above and below covered with appressed cinereous trichomes, bright green to pale dusty rose. **Inflorescences** terminal, similar in both staminate and pistillate individuals, ellipsoid, typically once compound; scape (17–)23–38(–46) cm, 0.4–1 cm diam, glabrous; internodes (0.7–)1.5–4.5(–7) cm; lowermost scape bracts foliaceous, (9–)11–22 cm, exceeding the internodes or rarely shorter than the internodes; internodes (0.5–) 1.5–4 cm; mid- and upper scape bracts exceeding the internodes, reflexed with age above the sheath, the blades very narrowly triangular to linear (1–)3–10 cm, apically spinose tipped, lepidote; primary bracts 0.8–5 cm; in staminate individuals the rachis 17–55 cm and 4.5–12 cm diam midway up the rachis; lateral branches subascending, straight or

becoming arcuate distally, weakly sulcate, subdensely flowered throughout, (1.8–) 2.5–7.5 cm; in pistillate individuals at or post-anthesis, the rachis 25–61 cm and (1.5–) 4.5–7 cm diam midway up the rachis, glabrous throughout; lateral branches subascending, straight or becoming arcuate distally, subdensely to densely flowered, (0.1–) 1.5–3.5(–4.5) cm, glabrous. **Staminate flowers** spreading to subascending; floral bracts chartaceous, navicular, ovate to oblong, 2–3.5(–5) X 1–2.5(–3) mm, apically attenuate-acuminate to apiculate, marginally finely denticulate to serrulate or erose distally, glabrous; pedicels weakly articulated with the rachis, conical, 1.2–3.5 mm long to the center of the base of the sepals, glabrous; sepals subequal, basally overlapping, flat to navicular, ovate to ovate-triangular, 1.5–2.7 X 1–1.8 mm, apically praemorse, marginally hyaline, glabrous; petals spreading, elliptic to ovate-elliptic, 3.5–4.5 X 1.9–3.3 mm, glabrous, cream-colored but often tipped rose. **Pistillate flowers** secund to ascending; floral bracts chartaceous, flat, ovate-triangular to oblong, 2–3.5 X 1.2–2 mm, apically apiculate to acuminate, marginally erose to very finely serrulate-denticulate, hyaline, glabrous; pedicels articulated with the rachis, 1.5–2.5 cm to the center of the base of the sepals, glabrous; sepals chartaceous, triangular, 1.8–2.5 X 1.2–1.5 mm, apically acuminate to apiculate, praemorse, glabrous, cream-colored; petals spreading at anthesis, triangular, 4–5 X 1.5–2.5 cm, marginally hyaline, glabrous, cream-colored but often tipped rose. **Capsules** with pedicels 2–4.5 mm; loculicidally and septically dehiscent, narrowly ovoid, (6–) 7.5–11 X 3–4.5 mm, dark castaneous.

**Distribution and habitat.** *Hechtia isthmusiana* is known only from the vicinity of the Isthmus of Tehuantepec where it grows terrestrially or epilithically on low rocky hillsides in full sun on boulders or areas shaded with thorn-scrub vegetation and tropical deciduous forests including *Plumeria* and *Bursera* at elevations between 200–600 ft.

**Discussion.** *Hechtia isthmusiana* is a species with relatively small rosettes that stands apart from most other *Hechtia* species in its long, caulescent, leafy stems. In growth habit, *H. isthmusiana* is most similar to *H. mooreana* L.B. Sm. from Guerrero but differs in many other characters, including its significantly larger flowers and capsules (pers. obs.). *Hechtia isthmusiana* appears most similar to *H. caudata*, which also occurs in southeastern Oaxaca. Both species have relatively large staminate and pistillate flowers and similar pedicel lengths, with those of pistillate flowers of *H. isthmusiana* 1.5–2.5 mm, while those of *H. caudata* range from 2–3 mm. Pistillate sepals of both species are similar in length, but those of *H. caudata* are slightly broader (1.2–1.5 mm vs 2–2.5 mm). Pistillate petal size is virtually the same in both taxa, 4–5 mm. Capsules of both species are ovoid and have similar lengths [*H. isthmusiana*: (6–) 7.5–11 mm vs *H. caudata*: 6.5–12.3 mm], but those of *H. isthmusiana* are slightly narrower than those of *H. caudata* (3–4.5 mm vs 4.5–5.5 mm). Staminate flower measurements are similar in both species, but the species do differ in vegetative and certain inflorescence characters.

With respect to vegetative characters, caulescence has only been observed in *Hechtia isthmusiana*. Moreover, rosettes of *H. isthmusiana* are smaller than those of *H. caudata* (2.5–5 dm vs 5–8 dm), and their leaves are much shorter than the those of *H. caudata* [14–36 cm vs (39–) 45–77 cm] and their blades are narrowly triangular (1.5–2.4 cm wide) and have shorter spines and are less aggressively spinose than those of the broader triangular blades (3.8–8 cm wide) of *H. caudata* [spines (0.5–) 1.8–2.5 mm vs 2.5–4 mm long].

The flowering rachises of *Hechtia isthmusiana* are generally shorter than those of *H. caudata* (♂: 17–55 cm vs 80–93 cm; ♀: 25–61 cm vs 47–75 cm). Both staminate and pistillate inflorescences of *H. isthmusiana* are once compound, but those of staminate inflorescences of *H. caudata* are once to occasionally twice compound. When lateral branches of both species are compared, those of both staminate and pistillate inflorescences of *H. isthmusiana* are only slightly shorter than those of *H. caudata*.



Figure 7 *Hechtia isthmusiana* Isotype of staminate plant (from Utley & Utley 8491, USF)



Figure 8. *Hechtia isthmusiana*. Isotype of pistillate plant (from Utley & Utley 8491, USF)

[♂: (1.8–)2.5–7.5 cm vs (3.5–)6–15.5 cm; ♀: (0.1–)1.5–3.5(–4.5) cm vs (2.3–)4–12 cm]. It should be noted that Smith (1961, 1974) characterized the inflorescences of *H. caudata* as lateral, but they are terminal like those of *H. isthmusiana* and most other *Hechtia* species.

**Additional specimens examined.** MÉXICO. Oaxaca. Isthmus of Tehuantepec 6.6 mi N of La Ventosa along MEX 185, Transisthmian Hwy, 600 ft, 29 Dec. 1988 (MEXU, USF); *Utley & Utley* 8327; along MEX 185 ca 6.5 mi N of La Ventosa, 600 ft, 19 Jul 1989, *Utley & Utley* 8404 (MEXU, USF); ca 4.1 mi E of La Ventosa on MEX 190, 200–300 ft, 18 Jul 1989, *Utley & Utley* 8403 (MEXU, USF); 6.5 km E of La Ventosa on MEX 190, 300 ft, 24 May 1990, *Utley & Utley* 8493 (MEXU, USF).

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## THE GENUS *ELODIUM* (BRYOPHYTA, HELODIACEAE): A HISTORY AND NEW COMBINATIONS

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### ABSTRACT

The Code does not recognize as orthographic variants names only differing by an initial “h” representing the spiritus asper, thus *Elodium* (Sull.) Austin and *Helodium* Warnst. (conserved against *Helodium* Dumort.) are both legitimate names as they have different types. If included in the same genus, *Elodium* takes precedence by Art. 14.5. The complex history of treatment of the spelling in the literature is summarized. *Thuidium elodioides* Renauld & Cardot ex Roell, usually recognized as a variety, is transferred to *Elodium* at the species level on the basis of new traits. New combinations are *Elodium elodioides* (Renauld & Cardot ex Roell) Eckel and *Elodium blandowii* (F. Weber & D. Mohr) Eckel.

**KEY WORDS:** *Elodium*, *Helodium*, *Elodium elodioides*, *Helodium blandowii*, spiritus asper

In the 2006 Vienna Code of Botanical Nomenclature, recommendations 60A1 and 2 state that transliteration of Greek words into Latin for new taxonomic names and epithets should conform to classical usage. The rough breathing sign, or spiritus asper, provided for Greek vowels and diphthongs and the letter “r” that begin a word should be transcribed in Latin as the letter “h.” Note that this recommendation is not an authorization to change all generic names derived from Greek words beginning with a spiritus asper (h-sound), as Robert Brown’s generic name *Eleocharis* (also derived from the Greek word for swampy ground (h)elos) has not been altered since its publication (Stearn 1983), and the Code (Art. 10.3, ex. 3) remarks that the protologue of *Elodes* Adans. (1763) included references to “*Elodes*” of Clusius (1601), without changing either to *Helodes*.

In 1856, W.S. Sullivant published section *Elodium* under the genus *Hypnum*, which would accommodate his new species “*Hypnum paludosum*, Sulliv.” from North America—a plant that does not occur in Europe (Hill et al. 2006). The name is derived from the Greek adjective (h)elōdēs, -es, ‘marshy, fenny,’ the adjective derived from the noun (h)elos, -eos (s.n.III) “the low ground by rivers, a marsh-meadow, marsh” (Liddell & Scott 1997), descriptive of the habitat of this moss. In Greek, the initial epsilon (ε) often has the spiritus asper, hence taxonomic names derived from this Greek word should be preceded by an “h”: *helodes*, or *helos, -eos*.

It is curious that Sullivant did not spell the section with an initial “h,” as he appears to have been proficient in classical languages, but he is not alone in preparing generic names this way. The spiritus asper and spiritus lenis (smooth breathing, absence of an h sound) often are accompanied by an accent at the beginning of a Greek word. It is easy to see this as a type-setter’s nightmare, especially in small, cheap, and popular versions of classical Greek dictionaries of the nineteenth century wherein smudgy inks and poor paper may make these marks ambiguous. That, coupled with the use of candles, poorly ground eye-glasses, and weak eyes played the devil with then contemporary taxonomists. It might be safer to assume a Greek word has no spiritus asper than to put one in when (hastily) preparing a manuscript for the printer.

### Sullivant, 1864

Apparently Sullivant knew of a moss species in North America (whether *Hypnum* or *Thuidium*) with *blandowii* as an epithet, but such did not appear in his 1856 text. In 1864, however, Sullivant remarked that *Hypnum paludosum* Sull. “Resembles *H. Blandowii*, with which it is not unfrequently confounded: but that species is a *Thuidium*, Bryol. Europ. ...” (Sullivant 1864). So it was known to Sullivant that *Hypnum blandowii* occurred in North America, but he did not place it in his section *Elodnum* or anywhere else.

### Austin, 1870

Austin (1870) treated *Elodnum* as a genus when he identified number 306 of his Musci Appalachian exsiccata as “*Elodnum paludosum*,” citing Sullivant’s 1864 treatment in the *Icones Muscorum* (on page 157, as *Hypnum paludosum* Sull.). Previously, the name of Austin’s taxon was *Hypnum paludosum* Sull. Austin apparently did not know that the name *Hypnum paludosum* Sull. was an illegitimate name, being a later homonym of *Hypnum paludosum* (Hedw.) P. Beauv., and had to be rejected. That left *Elodnum paludosum* Austin as the accepted name.

Austin included a note in Latin intended to credibly establish his genus: “*Folius saepe papillois: an Thuidii species?*” It perhaps should be noted that Austin was not sure whether “*Elodnum*” would not better be subsumed under the genus *Thuidium*. *Elodnum paludosum* Austin is then the type species of the genus *Elodnum*. Austin also added a description in Latin for his new variety *Fontinalis lescurei* var. *cymbifolia* Austin (number 248), a name still in use today. Also note that in Austin’s volume the genus *Omaha* by Bridel existed, for which the orthography was later conserved as *Homalia*, from another Greek adjective (*homalos*, referring to the flat leaves, with an initial spiritus asper.

### Lindberg, 1879

In Europe, Lindberg (1879) in his checklist of the Scandinavian flora, transferred Sullivant’s sectional name “*Elodnum*” to a subgenus of *Thuidium*. The species *Thuidium blandowii*, occurring in both North America and Europe, was the only species he recognized in the section.

### Lesquereux and James, 1895

Lesquereux and James (1895), in the United States, persisted in the use of *Thuidium* and *Elodnum* as subgenera of the genus *Hypnum*, with *Hypnum blandowii* F. Weber & D. Mohr under the former section, and *Hypnum paludosum* Sull. under the latter. These authors cited Sullivant’s exsiccata specimen no. 7 from the Musci Alleghenienses (Sullivant 1845), the Mosses of the United States (Sullivant 1856: 68), and the *Icones Muscorum* (Sullivant 1864: 157). There is no indication that they were aware of Austin’s generic name (*Elodnum*).

### Warnstorf, 1905

Warnstorf (1905) then used the name *Helodnum* for a genus using the authorities (Sull.) Lindb. Lindberg earlier (1879) had used *Elodnum* as a subgenus of the genus *Thuidium*. Both of the cited authorities used the name “*Elodnum*” and Warnstorf would have also, but he changed the orthography, as he wrote in a footnote, because of the spiritus asper with which the Greek word (*helos*) was spelled. *Helodnum* was to be pronounced that way, and transliterated into Latin that way. So, apparently, bibliographically, Austin’s name preceded Warnstorf’s name and Warnstorf’s name was considered by Warnstorf as only an orthographic variant of Austin’s, which Warnstorf corrected. The genus was cited by Warnstorf as *Helodnum* (Sull.) Lindb. Also, when Warnstorf changed the spelling, he created a later homonym for a vascular plant genus *Helodnum* Dumort., an issue that resulted later in the conservation of Warnstorf’s name over Dumort’s. Through conservation, the generic name became *Helodnum* Warnst. Also, through conservation, the type species was made

*Helodium blandowii* (F. Weber & D. Mohr) Warnst. The genericity of *Elodium* remained *E. paludosum* Austin.

#### Grout, 1934

Grout (1934), in a footnote to his treatment of the moss genus *Helodium* in North America, also corrected *Elodium* to *Helodium*, for he wrote “The Greek-derived *elodes* demands the aspirate in Latin according to classical authorities.” Grout mistakenly cited Sullivant’s *Elodium* as a subgenus, rather than a section. His footnote seems redundant, as Warnstorf, cited by Grout as the author of the genus name *Helodium*, had already established the corrected spelling. It is more likely, however, that Grout’s footnote applied more to correcting the spelling of another taxon, for which he made the combination in his paper *Helodium blandowii* var. *helodioides* (Renaud & Cardot) Grout.

This variety was originally published as *Thuidium elodioides* by Renaud and Cardot (in Roell 1893), based on specimens from North America. In the protologue to that species, the authors make clear that their new species is similar to (Austin’s) *Elodium paludosum*, and so the epithet of the new species was intended to allude to a resemblance to a species with the genus name *Elodium*. At that time, the only person to recognize *Elodium* as a generic name was Austin. The authority of the species *Elodium paludosum* was not given by the authors, had they known of Austin’s genus, the authorities would have been (Sull.) Austin.

*Thuidium elodioides* was subsequently reduced to a variety of *Thuidium paludosum* by Best (1896), retaining the initial “e” in the varietal epithet. Later, Grout (1929) transferred the variety *Helodium paludosum*, mistakenly attributing the authority to Best, when it was Grout himself that was the authority. Grout republished the corrected authorial citation in a subsequent publication as *Helodium paludosum* var. *helodioides* (Renaud & Cardot) Grout, with an initial “h” (Grout 1934).

Grout’s corrected citation in 1934 also included attaching the initial “h” to the spelling of the varietal name, which he justified as based on classical usage (the spiritus asper before the epsilon of *elōdēs*)—essentially a reiteration of Warnstorf’s correction of the generic name (from *Elodium* to *Helodium*) (Warnstorf 1905). However, the correct citation of this variety, whose changed status was authored by Grout, is *Helodium paludosum* var. *elodioides* (Renaud & Cardot) Grout.

#### Little, 1943

Little (1943) discussed the genus *Helodium* as a possible later homonym of Austin’s generic name *Elodium* when Austin established *Elodium paludosum* as a new combination (Austin 1870). Little determined that “There is no indication that a new genus was intended” by Austin when Austin made his short citation in “this book” being “just a printed copy of the labels of Austin’s specimens of mosses ...” Little suggested that Austin’s name was “improperly published” and he questioned whether Austin created a “new monotypic genus with a species transfer,” i.e. from Sullivant’s *Hypnum paludosum* to Austin’s *Elodium paludosum*. It was because Grout (1934) cited Warnstorf’s rendition “*Helodium*” as validly published that Little rejected Austin’s contribution as an “irregularly published name.” Little stated that “the genus was not considered [by Grout] as validly published until 1905.” It seems unfair to attribute irregularity to Austin’s publication when other taxa have been and are still recognized from the same book (Austin 1870), such as the variety *cymbifolia* of *Fontinalis lescurei* mentioned above. Other authors, such as Sullivant, used Austin’s exsiccata to publish new combinations, such as *Anoetangium peckii* (Sull.) Sull. ex Austin, a combination accompanied by a Latin description. As to this, Grout’s transfer, mentioned above, of Best’s *Thuidium paludosum* var. *elodioides* (Renaud & Cardot) Best to *Helodium paludosum* var. *elodioides* (Renaud & Cardot) Grout was not considered invalid and Grout’s 1929 publication was not “irregular” even though the text was a simple list of names and the nomenclature was somewhat informal.

### Crum, Steere, Anderson, 1965, 1981

In 1965, Crum, Steere and Anderson published a continuation of nomenclatural changes in preparation for their checklist of North American mosses. In it *Thuidium elodioides* Renaud & Cardot ex Roell was transferred to another species as a variety: *Helodium blandowii* (F. Weber & D. Mohr) Warnst. var. "*elodioides*" (Renaud & Cardot ex Roell). The epithet Renaud and Cardot used was "*elodioides*" and so one would think the new varietal epithet would be spelled the same way. For some reason it was not. Also, when Crum and Anderson presented the variety in 1981 in their Mosses of Eastern North America, the varietal epithet was spelled "*elodioides*." The authors remarked that "The original spelling of the epithet '*elodioides*' is the correct form, and very likely the generic name should be spelled *Elodium*, except for conservation of *Helodium* Warnst. against the earlier *Elodium* (Sull.) Aust. and *Hypnum* sect. *Elodium* Sull." The authors perhaps had taken the view that the intention of the authors of taxonomic names took precedence over classical usage, or classical orthography. Whether Sullivant intended to omit the initial "h" in his sectional name "*Elodium*," it appears to be assumed that this was not an error on Sullivant's part. Certainly when Austin created the genus *Elodium*, the generic orthography was not based on classical usage but on Sullivant's sectional name. Renaud and Cardot's epithet for *Thuidium elodioides* makes clear reference to the generic name *Elodium* associated with Sullivant's section *Elodium* of *Hypnum* and Austin's genus *Elodium* and subsequent species *Elodium paludosum*. In other words, the choice of whether to spell with an "h" seemed to Crum and Anderson to reside in the author's citation of nomenclature, not classical words. Crum and Anderson lent weight to a presumed intention of Sullivant to create a name that ignored the spiritus asper of the Greek orthography.

However, as Crum and Anderson related, it is the conservation of Warnstorf's name *Helodium* that settled the issue. The conservation of *Helodium* Warnst., however, was not "against the earlier *Elodium* (Sull.) Aust. and *Hypnum* sect. *Elodium* Sull." but rather against another generic name with the identical spelling, *Helodium* Dumort. This genus was not a bryophyte but a dicotyledonous vascular plant in the Umbelliferae described in 1827 (now *Helosciadium*; McNeill 2006). According to the Code, the type of *Helodium* Warnst. is *Helodium blandowii* (F. Weber & D. Mohr) Warnst., which totally removes Austin's name *Elodium* and its type (*Elodium paludosum* Aust.).

If Warnstorf had not altered the spelling of *Elodium* to *Helodium*, there would have been no later homonym issue with Dumortier's earlier name of the same spelling and no need for conservation. Warnstorf, then, would have used *Elodium* as the generic name, and it would have been recognized at some point that Austin already had coined that name. Austin would then have been the authority, and *Elodium paludosum* the type species for it. Even though *Helodium* and *Elodium* are philologically identical names, in the context of the Code they are not homotypic synonyms and both names are now based on different types.

### Conservation of *Helodium* Warnst.

Whether one agrees with the above summation or not, the issue was closed when Warnstorf's genus *Helodium* was conserved against an earlier homonym by Dumortier for a species of vascular plant. Two more taxonomic authorities added to their views on the genus *Helodium* and its preferred spelling (with an initial "h") and the matter appeared to be closed. However, the entire issue was raised again by Crum and Anderson in 1981, who suggested the correct form for the epithet of *Helodium blandowii* var. *elodioides* was to be spelled without the initial "h" and that the generic name should be spelled *Elodium* except for the conservation of Warnstorf's corrected name as "*Helodium*." The authors, however, did not raise this issue again in subsequent publications. Crum et al. (1965) transferred the var. "*elodioides*" from a variety of *Helodium paludosum* to a variety of *H. blandowii*. For this transfer they spelled the epithet "*helodioides*." In their 1981 publication they wrote it "*elodioides*" with their justification. However, in the two checklists of the mosses of North

America to which these authors contributed (Crum et al. 1973; Anderson et al. 1990), both times the epithet was spelled “*helodioides*” (in both the main catalogue and the synonym list), and the issue of the alternate spellings was not revisited.

According to ICBN Art. 14.5, “When a conserved name competes with one or more names based on different types and against which it is not explicitly conserved, the earliest of the competing names is adopted. ...” Given that the two generic names are considered different by the Code (e.g., *Homalium* is conserved against *Omalium*) and that they have different types, the two generic names *Elodium* (Sull.) Austin and *Helodium* Warnst. are legitimate.

#### The complex history of *Thuidium elodioides* Ren. & Card. ex Roell

*Thuidium elodioides* Renault & Cardot ex Roell was originally published by Renault and Cardot in 1893. The new species was assigned to the genus *Thuidium*, not *Elodium* although it shared characteristics of both genera (hence the epithet “*elodioides*” in the genus *Thuidium*). The authors indicated that the habit of *Thuidium elodioides* is similar to that of *Elodium paludosum*, but that the new species differed by the leaves more shortly acuminate, by the cauline leaves fimbriate at the base, and by the shorter cells, which are elliptic and oval and papillose (Roell 1893). *Helodium paludosum* (Aust.) Broth. essentially does not have fimbriations along the basal margins of the leaves and where they appear to have them, it is generally due to stem cells covered with paraphyllia that strip off with the leaves at the insertion but are not a part of the leaf itself.

Renault and Cardot indicated that the new species in turn is distinguished from *Thuidium blandowii* by the habit more slender, the stems [branches] more remote and less regularly pinnate, the cauline leaves narrower, the cells more lax, the paraphyllia shorter, and the perichaetial leaves narrower, entire, very long-subulate. The type specimen is sterile, but a specimen had been very recently found in Ohio, around New-Bremen, with old and younger pedicels (setae) but apparently without capsules. They declared that *Thuidium elodioides* was an excellent (ausgezeichnete) species right in the morphological middle between *Elodium paludosum* and *Thuidium blandowii*.

Three years later, Best (1896) in his treatment of *Thuidium* reduced *Thuidium elodioides* to a variety. The genus *Helodium* in North America was not recognized by this author, and both species (*H. paludosum* and *T. blandowii*) were placed in a subgeneric category of *Thuidium* named *Heterothuidium*, perhaps to emphasize the rather strong differences between the two species in it and the rest of the genus (*Euthuidium*). The author obviously thought to align *Thuidium elodioides* with *T. paludosum*, rather than *T. blandowii* although his description of the variety does not give the reason he used to suggest it to be nearly within the variation of *Thuidium paludosum*. The author found the variety “with the type,” i.e. the typical variety of *Thuidium paludosum*, and estimated, at that time, the variety to be “more common from New York (E.G. Britton) westward. Indiana (Schuh).” The original locality was from Hobart, Indiana, along the Calumet River, with mention of a specimen from Ohio (Roell 1893).

Crum et al. (1965) published a continuation of nomenclatural changes in preparation for their checklist of North American mosses and in it the variety *helodioides* [sic] was transferred to the species *Helodium blandowii* (F. Weber & D. Mohr) Warnst. as *Helodium blandowii* var. *helodioides* (Renault & Cardot ex Roell) H.A. Crum, Steere, & L.E. Anderson. When the variety was subsequently cited by Crum and Anderson (1981) in their Mosses of Eastern North America, the authors decided to remove the initial “h” in the orthography of both the variety and, erroneously, in the 1965 new combination. In the treatment of the new variety by Crum and Anderson (1981), there is no discussion regarding evidence used to associate the variety (*h*)*elodioides* with *Helodium blandowii* rather than *H. paludosum*. The distribution of the variety seems to overlap more with the south-ranging *H. paludosum* in its east-central, Great Lakes, and eastern seaboard area rather than

with the more widespread northern-boreal to southwestern North American distribution of *H. blandowii*. There is no such variety noted in the European variation of that species (Hill et al. 2006).

#### The taxonomic placement of *Thuidium elodioides*

Superficially, the var. (*helodioides*) does have characters resembling *Helodium blandowii* as originally discussed in 1893 by Renaud and Cardot. But it also has many of the characters of *H. paludosum*. While preparing a treatment of the genus for the Flora of North America, two additional characters quite conservative in other, related taxa were identified for the variety: it possessed a stem central strand as does *H. paludosum* (but not *H. blandowii*) and the seta and capsule dimensions are also only consistent with those of *H. paludosum*. These characters make this taxon unlikely to be part of the variation of *H. blandowii* nor is there intergradation. The characters of var. *elodioides* mentioned above that it shares with *Helodium blandowii* clearly distinguish it from *H. paludosum*. All three species belong in the genus *Elodium* (Sull.) Austin, of which the later *Helodium* Warnst. is a taxonomic synonym following Art. 14.5.

#### Needed new combinations

**Elodium elodioides** (Renaud & Cardot ex Roell) Eckel, comb. nov. **BASIONYM:** *Thuidium elodioides* Renaud & Cardot ex Roell, Hedwigia 32: 308. 1893. *Thuidium paludosum* var. *elodioides* (Renaud & Cardot ex Roell) Best, Bull. Torrey Bot. Club 23: 90. 1896. *Elodium paludosum* var. *elodioides* (Renaud & Cardot ex Roell) Best, Man. Mosses W. Pennsylvania 262. 1913. *Helodium paludosum* var. *elodioides* (Renaud & Cardot ex Roell) Grout, Check List Pleuroc. Moss. N. Amer. 23. 1929. *Helodium blandowii* var. *elodioides* (Renaud & Cardot ex Roell) H.A. Crum, Steere, & L.E. Anderson, Bryologist 68: 432. 1965 (1966) as “*helodioides*.”

**Elodium blandowii** (F. Weber & D. Mohr) Eckel, comb. nov. **BASIONYM:** *Hypnum blandowii* F. Weber & D. Mohr, Bot. Taschenbuch 332. 1807. *Leskea blandowii* (F. Weber & D. Mohr) Mitt., J. Proc. Linn. Soc., Bot. 8: 44. 1864. *Thuidium blandowii* (F. Weber & D. Mohr) Schimp., Bryol. Eur. 5: 166. 486 (Fasc. 49–51 Mon. 10. 6). 1852. *Helodium blandowii* (F. Weber & D. Mohr) Warnst., Krypt.-Fl. Brandenburg, Laubm. 692. 1905.

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NOMENCLATURAL NOTES ON *DINEBRA*, *DIPLACHNE*, *DISAKISPERMA* AND  
*LEPTOCHLOA* (POACEAE: CHLORIDOIDEAE)

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ABSTRACT

This paper provides several nomenclatural modifications based on a recent molecular study of *Leptochloa*. One generic transfer and four new varietal combinations are proposed for *Dinebra* Jacq. One orthographic correction and three new varietal combinations are provided in *Diplachne* P. Beauv. Two corrections are made for the specific epithets of *Disakisperma*. One orthographic correction is provided for *Leptochloa*.

**KEY WORDS:** Chloridoideae, *Dinebra*, *Diplachne*, *Disakisperma*, *Leptochloa*, nomenclature, Poaceae

A recent study proposed splitting the grass genus *Leptochloa* P. Beauv. into five genera, based on molecular data from five plastid markers and the nuclear ITS regions (Peterson et al. 2012). The present paper corrects some orthographic errors in Peterson et al. (2012) for *Diplachne*, *Disakisperma*, and *Leptochloa* and proposes new combinations in *Dinebra* and *Diplachne*.

***Dinebra decipiens* var. *asthenes* (Roem. & Schult.) P.M. Peterson & N. Snow, comb. nov.**  
Basionym: *Poa asthenes* Roem. & Schult., Syst. Veg. 2: 574. 1817.

***Dinebra decipiens* var. *peacockii* (Maiden & Betcher) P.M. Peterson & N. Snow, comb. nov.**  
Basionym: *Diplachne peacockii* Maiden & Betcher, Agric. Gaz. New South Wales 15: 925. 1904.

***Dinebra divaricatissima* (Blake) P.M. Peterson & N. Snow, comb. nov.** Basionym: *Leptochloa divaricatissima* Blake, Contrib. Queensl. Herb. 14: 8. 1972. This combination was not made in Peterson et al. (2012) but we feel the species is sufficiently similar in overall morphology to confidently place in *Dinebra*, given the wide taxonomic sampling of that study and previous monographic work (Snow 1997).

***Dinebra panicea* var. *brachiata* (Steud.) P.M. Peterson & N. Snow, comb. nov.** Basionym: *Leptochloa brachiata* Steud., Syn. Pl. Glumac. 1: 209. 1854.

***Dinebra panicea* var. *mucronata* (Michx.) P.M. Peterson & N. Snow, comb. nov.**  
Basionym: *Eleusine mucronata* Michx., Fl. Bor.-Amer. 1: 65. 1803.

***Diplachne fusca* subsp. *fascicularis* (Lam.) P.M. Peterson & N. Snow, Ann. Bot. 109: 1327,**  
an orthographic correction for the incorrectly formed epithet *fasciculata*. Basionym: *Festuca fascicularis* Lam., Tabl. Encycl. 1: 189. 1791.



**Diplachne fusca** var. **fascicularis** (Lam.) P.M. Peterson & N. Snow, comb. nov. Basionym: *Festuca fascicularis* Lam., Tabl. Encycl. 1: 189. 1791.

**Diplachne fusca** var. **muelleri** (Benth.) P.M. Peterson & N. Snow, comb. nov. Basionym: *Diplachne muelleri* Benth., Fl. Austral. 7: 619. 1878.

**Diplachne fusca** var. **uninervia** (J. Presl) P.M. Peterson & N. Snow, comb. nov. Basionym: *Megastachya uninervia* J. Presl, Reliq. Haenk. 1(4-5): 283. 1830.

*Disakisperma dubium* (Kunth) P.M. Peterson & N. Snow, Ann. Bot. 109: 1327, an orthographic correction from *dubia* to accommodate the neuter generic name.

*Disakisperma obtusiflorum* (Kunth) P.M. Peterson & N. Snow, Ann. Bot. 109: 1327, an orthographic correction from *obtusiflora* to accommodate the neuter generic name.

*Leptochloa crinita* (Lag.) P.M. Peterson & N. Snow, Ann. Bot. 109: 1327, an orthographic correction for the incorrectly published epithet *crinata* (Peterson et al. 2012: 1327).

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## THE STATUS OF *CASTILLEJA TOMENTOSA* A. GRAY (OROBANCHACEAE) AND FIRST RECORDS FOR THIS SPECIES FROM THE UNITED STATES

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### ABSTRACT

*Castilleja tomentosa* A. Gray, described from Sonora, Mexico, appears to be a bona fide species readily distinguished from several morphologically similar and presumably related *Castilleja* species of the southwestern USA and northwestern Mexico. First records of this rare species for the USA are presented, along with a key and photographs for separating it from species with which it might be confused. Comments on its conservation status are provided.

**KEY WORDS:** Orobanchaceae, *Castilleja integra*, *Castilleja lanata*, *Castilleja stenophylla*, *Castilleja tomentosa*, endangered species, rare species, Animas Valley, Hidalgo County, Sonora

*Castilleja tomentosa* A. Gray was first published in 1859 in the Botany of the Boundary Survey (A. Gray 1858), wherein Gray also described *Castilleja lanata* A. Gray and *Castilleja integra* A. Gray, two of the three species of the inland southwestern United States and northwestern Mexico with which it might be confused. The third is *Castilleja stenophylla* M.E. Jones, a species of northwestern Mexico described much later (Jones 1908). Aside from the Latin diagnosis, Gray remarked in the protologue that *C. tomentosa* was distinguished from *C. lanata* and from the Californian species *Castilleja foliolosa* Hook. & Arn. by its pubescence, with "the wool less dense and floccose than in *C. lanata*" and in the calyx being "... different, and apparently fully as long as the galea." In the Latin diagnosis, Gray mentioned several features key to its identification, "...floralibus (=bracts) trifidis superne coloratis..." and "calycis sunequaliter bifidi lobis semibifidis lanceolatis acutis...." Gray based his description of *C. tomentosa* on two herbarium sheets from a single collection obtained by George Thurber on "dry hillsides" near Mabibi, Sonora in June 1851. Mabibi is a small community located in the eastern Sierra Madre Occidental in northeastern Sonora about 40 km south of the USA-Mexico border. Four years later Gray (1862) changed his mind and reduced *C. tomentosa* to synonymy under *C. integra*, noting that the later should include "my *C. tomentosa*, from Mabibi, Arizona (sic), Thurber, appears to be a more tomentose state of the same species, the flowers of the specimen not well developed." While Gray was correct in rejecting his original diagnosis of the calyces being "apparently fully as long as the galea," he missed completely an important and consistent difference between *C. tomentosa* and *C. integra*, the characteristics of the distal leaves and especially the floral bracts.

Following Gray's reduction of *Castilleja tomentosa* to synonymy under *C. integra*, this entity and Thurber's collection of it were almost completely forgotten in the botanical literature or were routinely listed or annotated in synonymy, as in Eastwood's revision of *Castilleja* in Mexican (1909). T.I. Chuang (1993-1994) annotated the GH sheets of Thurber 438 as *C. lanata*, which is clearly incorrect in the structure of the calyces alone. G.L. Nesom, who worked with Mexican *Castilleja* species in the early 1990's, was undecided about *C. tomentosa* and annotated the holotype (1992) only with the type name, not referring it to another species. Boufford and Nesom (1993) designated the holotype (Fig. 1) and an isotype for *C. tomentosa*, based on the two sheets of Thurber 438 at GH. Neither in this paper nor in Nesom's several subsequent papers on Mexican *Castilleja* species was the

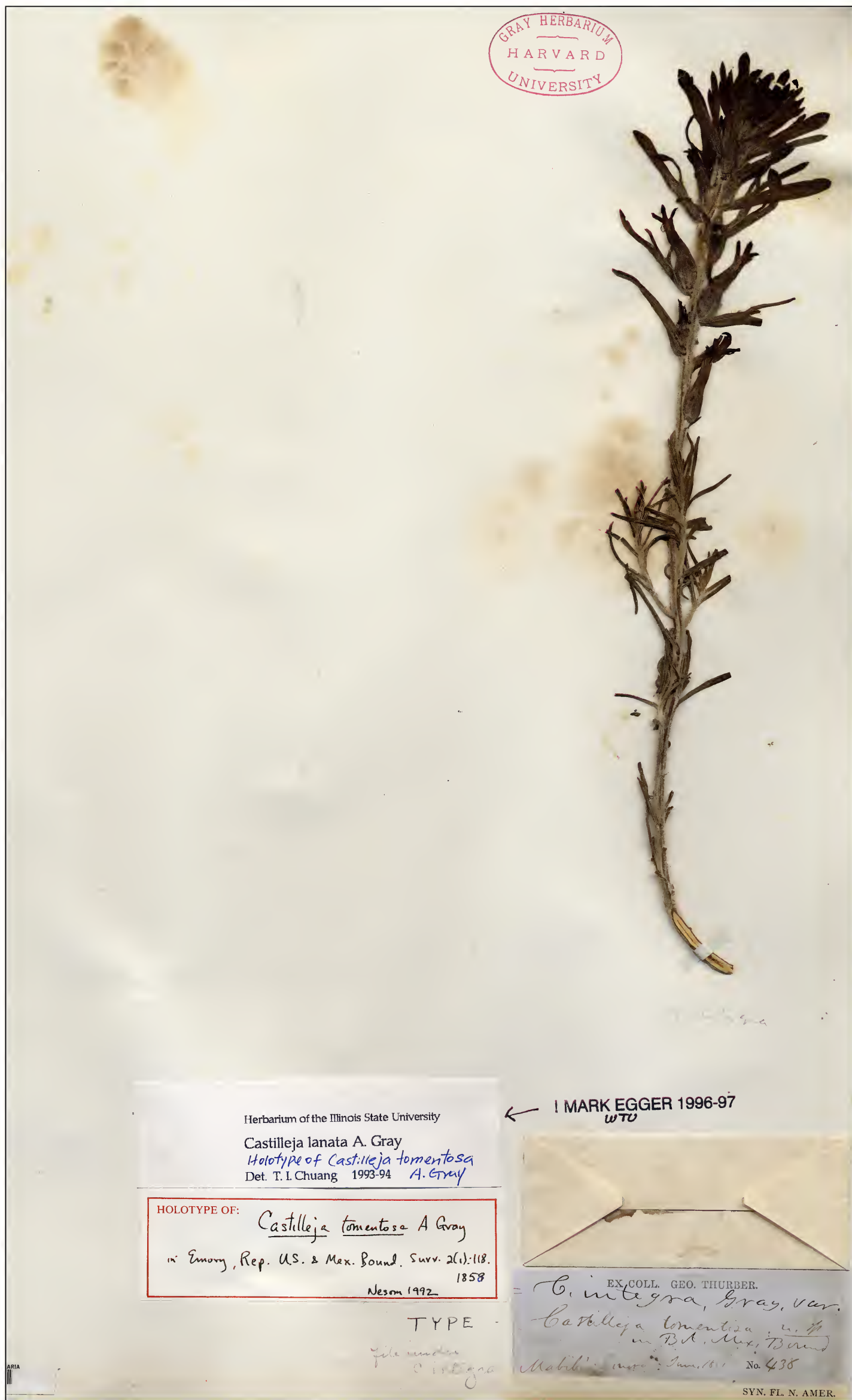


Figure 1. Holotype of *Castilleja tomentosa* A. Gray, GH. My annotation agreeing with the identification of the specimen as *C. lanata* from 1996-1997 is incorrect.

identity of *C. tomentosa* discussed in print. However, in a personal communication to me in the late 1990's Nesom mentioned that the type material of *C. tomentosa* seemed very close to *C. stenophylla*.

On 26 August 1994, while conducting fieldwork in the Animas Valley of Hidalgo Co., New Mexico, I encountered several plants of an unusual *Castilleja* near the headquarters building of the Animas Ranch. I documented these plants with photos and a unicate collection (Egger 677, WTU, Fig. 2), but I dismissed them at the time as variant *C. integra*. Though I continued to wonder about this population for a number of years, I did not pursue the matter further, likely since I had not yet seen any material from the type collection of *C. tomentosa*.

Then, starting around 2007, I became involved in the writing of a *Castilleja* treatment for the Flora of the Four Corners Region, Vascular Plants of the San Juan River Drainage. (in press) and corresponded with Ken Heil of SJNM, the editor and a primary author of the flora. He brought my attention to a collection of *C. tomentosa* he made in 1997 (Heil 11,249 SJNM). Eventually, I compared this and later collections by Heil and associates with the type of *C. tomentosa* and realized their congruity as well as the fact that they also matched the characters of the plants I encountered in 1994 (Fig. 3).



Figure 2. *Castilleja tomentosa*, Egger 667, WTU, live plants and specimens, first USA collection.

### Conservation status

*Castilleja tomentosa* is only known from the type locality in Mexico and from four collection sites in and near the Animas Valley in southern Hidalgo Co., New Mexico, in the USA. The known collection sites are all within 40-50 straight-line km of each other. I have not conducted an

exhaustive search of southwestern herbaria for mislabeled specimens, though there may well be such collections to be identified. In any case, *C. tomentosa* should be regarded as a globally endangered species, at least until further research can be conducted to evaluate its true abundance. It is also interesting to note that *C. tomentosa* closely shares the distribution of another very rare *Castilleja* species, *C. ornata* Eastw., which is also known only from a handful of sites in Mexico and from small populations in the southern Animas Valley, New Mexico (McIntosh, 1994), and which is similarly endangered.



Figure 3. Isotype of *Castilleja tomentosa* A. Gray, NY (L); *C. tomentosa*, Egger 667, WTU (R).

#### Verified collections of *Castilleja tomentosa*

**MEXICO: Sonora.** Dry hillside, Mabibi, Jun 1851, *Thurber 438* (holotype: GH!; isotypes: F!, GH!, NY!). **USA: New Mexico.** Hidalgo Co.: Animas Valley, dry, grassy meadow along NM Hwy 338, ca. 1/4 mi. S of Animas Ranch headquarters, 26 Aug 1994, *Egger 677* (WTU); North of Fitzpatrick's Ranch House, Gray Ranch, Alkali sacaton community; 31°21.35' N, 108°51.928' W, T32S, R20W, S.27, SE1/4, SW1/4, 4990', 7 Aug 1997, *Heil 11,294* (SJNM); Diamond A Ranch (Gray Ranch), 0.7 mi. SW of Fitzpatrick's Camp, 31°23.479' N, 108°52.040' W, 5220', 30 Jul 2010, *Heil & O'Kane 32664* (GH, SJNM, TEX, US, WTU[2]); Clanton Draw Road, side road just W of Forest Service boundary, 31.52630° N, 108.9774° W, 5430', 16 Sep 2010, *Heil & Penn 33070* (SJNM, WTU).

#### Identification of *Castilleja tomentosa*

*Castilleja tomentosa* is readily separated from other similar *Castilleja* species of the region in which it occurs by the following key. A visual guide to representative live specimens of each species addressed in the keys is also presented below (Figs. 4–7). A full description of *C. tomentosa* will be provided in the *Castilleja* treatment in the Flora of North America (in prep).

**A key to the *Castilleja* species of southern Arizona and New Mexico and adjacent Sonora and Chihuahua having lanate to tomentose stems**

1. Bracts usually entire to less often with one pair of short, lanceolate lateral lobes, almost always originating from the middle of the blade or above; bracts proximally greenish.
  2. Bracts almost always entire, clearly lanceolate and distally acute; leaves usually linear and strongly differentiated from the bracts; not known to occur north of the Mexican border ..... ***Castilleja stenophylla***
  2. Bracts usually entire and distally broadly rounded but often some with a pair of short, lanceolate lateral lobes; leaves linear to linear-lanceolate and not as strongly differentiated from the floral bracts; common in appropriate habitats north of the USA-Mexico border, extending into extreme NE Sonora and northern Chihuahua, Mexico ..... ***Castilleja integra***
1. Bracts usually deeply divided with one pair of much longer, narrowly oblanceolate to less often lanceolate to linear-lanceolate lobes, usually originating from well below the middle of the blade; bracts proximally grey-green to greenish tinged with pale root-beer brown.
  3. Primary lobes of calyces entire and rounded, emarginate, or shallowly cleft into obtuse to rounded lobes; stem pubescence usually densely lanate, with branched or unbranched hairs ..... ***Castilleja lanata***
  3. Primary lobes of calyces much more deeply cleft into linear-lanceolate secondary lobes; stem pubescence usually less dense and tomentose with unbranched hairs ..... ***Castilleja tomentosa***



Figure 4. *Castilleja stenophylla*. Woodland shade form, Sierra La Raspadura, Chihuahua, Mexico, 18 Aug 1998, Egger 1050 (L); open meadow form, SW of La Junta, Chihuahua, Mexico, 18 Aug 1998, Egger 1044 (R).





Figure 5. *Castilleja integra*. Form with entire bracts, NW of Flagstaff, Coconino Co., Arizona, 27 Aug 1994, Egger 674 (L); form with lobed bracts, near Elizabethtown, Colfax Co., NM, 31 Jul 2001, Egger 1173 (R)



Figure 6. *Castilleja lanata*. E of Van Horn, Pecos Co., Texas, 19 Apr 1997, Egger 842.



Figure 7. *Castilleja tomentosa*. Mature plant, near Animas Ranch Headquarters, Animas Valley, Hidalgo Co., New Mexico, 26 Aug 1994, Egger 677 (L); young plant and different color form, SW of Fitzpatrick's Camp, Animas Valley, Hidalgo Co., New Mexico, 30 Jul 2010, Heil & O'Kane 32664 (R).

#### ACKNOWLEDGEMENTS

I thank Ken Heil and Steve O'Kane of SJNM for photographs and for the loans and gifts of specimens from their collections, and I appreciate Ken's encouragement, feedback, and support in pursuit of the identity of the Animas Valley plants as well as his review of this paper. I also thank Laird McIntosh for first introducing me to the botanical wonders of the Animas Valley, Guy Nesom for timely correspondence and for sharing his notes concerning the type collection of *C. tomentosa*, and the personnel of GH, NY, and WTU for assistance with loans, type photos, and other matters. I also thank the Animas Foundation and the Diamond A Ranch for permission to conduct fieldwork on their lands. Finally, I thank The Nature Conservancy, the Animas Foundation, ranchers of the Malpai Borderlands Group, botanists, and others involved in first drawing attention to the importance of Hidalgo County in general and the Animas Valley and Animas Mountains in particular to the preservation and appreciation of the biodiversity of southwestern North America.

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### THREE NON-NATIVE VASCULAR PLANT SPECIES NEW TO ALABAMA

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#### ABSTRACT

*Allium neapolitanum* (Amaryllidaceae), *Arachis glabrata* (Fabaceae), and *Ornithogalum mutans* (Hyacinthaceae) are reported new for Alabama from recent collections.

**KEY WORDS:** Alabama, non-native, *Allium neapolitanum*, *Arachis glabrata*, *Ornithogalum mutans*

Continued botanical explorations in Alabama have yielded three recent collections of exotic species by the author that are deemed noteworthy. In reviewing pertinent literature, including the recently published checklist of vascular plants for Alabama, as well as web based resources, including the Alabama Plant Atlas (Kral et al. 2012), it is believed that these collections represent the first vouchers from Alabama for each of the three species (Mohr 1901; Kral et al. 2011; Kral et al. 2012; USDA, NRCS 2012).

*ALLIUM NEAPOLITANUM* Cirillo (Amaryllidaceae) — is a native of the Mediterranean region of southern Europe, where it frequents pastures and cultivated grounds as well as dry open places (Stearn 1980). The naturalized occurrences in North America have been attributed to garden escapes (McNeal & Jacobsen 2002). Before this current report, the species had been documented as naturalized in California, Florida, Georgia, and Louisiana (USDA, NRCS 2012). The addition of Alabama seems to continue a trend of the occurrence in states with warmer climates. From this, discoveries of other naturalized populations may continue to be made in other southern states.

The population vouchered below was growing in a vacant disturbed lot in an older part of town. About 25 individuals in three stands were observed at this locality, but it is unclear how many of these were the result of clonal divisions in the substrate. In addition to the vouchered collection, the species was also observed growing naturalized at two additional localities in the same town on the same day the voucher was collected.

Voucher specimens: **Alabama.** Marengo Co.: Demopolis, area just SW of jct. between E Franklin St. and S Strawberry Ave., 32.51575°, -87.83685°, 24 Feb 2012, Keener 6855 (UWAL, duplicates TROY, VDB).

*ARACHIS GLABRATA* Bentham (Fabaceae) — is a native of southern Brazil, Paraguay, and extreme northeastern Argentina (Krapovikas & Gregory 2007). It has been introduced into the USA, particularly Florida, where it has been used as a forage plant (Krapovikas & Gregory 2007). Since its introduction into Florida, it has been documented as naturalized at several localities along roadsides and adjacent fields (Isely 1998).

In fairly recent time, there has been a bit of taxonomic discrepancy regarding the naturalized material of *Arachis* in Florida. This may be partly due to Wunderlin and Hansen (2003), who treated the naturalized material as *A. prostrata*, noting that *A. glabrata* had been previously "misapplied". However, in a more recent revision of their publication, Wunderlin and Hansen (2011) have changed the taxon to *Arachis glabrata*, which also matches their treatment for the species found in the Atlas of

Florida Vascular Plants (2012). This also seems to be congruent with the generic monograph work of Krapovikas and Gregory (2007). However, the USDA PLANTS database (USDA, NRCS 2012) maintains that *A. prostrata* is the commonly escaped *Arachis* in Florida, while *A. glabrata* is "excluded" from the USA flora.

The population vouchered below was found along a rural roadside and adjacent moist roadside ditch. It was growing with *Xyris* sp. and several species of *Carex* and *Rhynchospora*. It was also observed in a nearby field, where an interview with the landowner revealed that he had planted "Perennial Peanut" in his field "years ago" and that it is surviving without aid other than grazing. The vouchered plants were collected some distance away from his field, well away from the cultivated area. From this it was clear that the species is spreading from cultivation.

Voucher specimens: **Alabama**. Baldwin Co.: 6.1 air mi. SW of Seminole, along Co. Rd. 91 (Gardner Rd.) ca. 0.4 mi. W of Le Frank Rd., 30.46570°, -87.50154°, 3 Jul 2011, Keener 6596 (UWAL, duplicates TROY, VDB).

*ORNITHOGALUM NUTANS* Linnaeus (Hyacinthaceae) — is native to the southeastern portion of the Balkan Peninsula, including Greece, Bulgaria, and Turkey (Zahariadi 1980). Often grown as a garden flower, it has become widely naturalized as an escape from cultivation in Europe and other parts of the world including North America (Zahariadi 1980; Straley & Utech 2002). In the USA, it has specifically been documented from several northeastern and midwestern states, reaching south to Arkansas and North Carolina. It has also been documented in northwestern states such as Oregon and Washington (Straley & Utech 2002; USDA, NRCS 2012).

The population vouchered below was found in an approximately 0.5 acre row-crop garden area. The population contained about 30 plants growing among many other early spring exotic weeds often seen in similar fallow situations. The plants were randomly distributed throughout the plot with no evidence of persistence from cultivation.

Voucher specimens: **Alabama**. Greene Co.: 0.6 air mi. E of Eutaw, along US Hwy 11 (Tuscaloosa St.) just W of jct with 4th Ave., 32.84050°, -87.88132°, 6 Mar 2012, Keener 6886 (UWAL, duplicates TROY, VDB).

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## NEW SPECIES AND NOTES ON *BEGONIA* (BEGONIACEAE) FROM MÉXICO AND CENTRAL AMERICA

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### ABSTRACT

Ten new species of *Begonia* are described, discussed, and illustrated: *Begonia wilburi* Burt-Utley & Utley, *Begonia gentryi* Burt-Utley & Utley, *Begonia liesneri* Burt-Utley & Utley, *Begonia mcpersonii* Burt-Utley & Utley, *Begonia pseudopeltata* Burt-Utley & Utley, *Begonia aguabuenensis* Burt-Utley & Utley, *Begonia sukutensis* Burt-Utley & Utley, *Begonia panamensis* Burt-Utley & Utley, *Begonia gracilioides* Burt-Utley & Utley, and *Begonia tenuis* Burt-Utley & Utley. *Begonia militaris* L.B. Sm. & B.G. Schub. is evaluated and *B. sciadophora* L.B. Sm. & B.G. Schub. is synonymized with it, while *B. pustulata* Liebm. and *B. ludiera* A. DC. are recognized as species endemic to México.

**KEY WORDS:** Begoniaceae, *Begonia*, México, Central America, Colombia

Continuing research with the Begoniaceae and preparation of the Begoniaceae for the Flora Mesoamericana has resulted in the recognition of a number of new species (Burt-Utley & Utley 1999; 2011), including the 10 that are described herein. One of these species, *B. wilburi*, is unique in Central America because of its potential dioecy and is only one of two species in the Flora with turbinate capsules. The other known obligate dioecious species in México and Central America are from México, *B. extranea* L.B. Sm. & B.G. Schub. (Guerrero, México, Michoacán, and Jalisco), and *B. nemoralis* L.B. Sm. & B.G. Schub. (Michoacán), both of which are tuberous. Another tuberous species from México and Central America, *B. biserrata* Lindl., is either monoecious or dioecious (Burt-Utley & McVaugh 2001). Two other species also stand apart from other *Begonia* in Chiapas and Central America, *B. gracilioides* and *B. tenuis*, because they are tuberous and also produce bulbils in their leaf axils that can then develop into new individuals. In Central America, similar bulbils have been observed only on *B. weberlingii* Irmsch. and *B. ignea* (Kl.) A. DC. In contrast, in México, 17 of the 37 known tuberous taxa are known to produce bulbils and are most common in central and western México (Burt-Utley, pers. obs.). The species described represent diverse phenetic groups including sect. *Casparya* (Kl.) A. DC., sect. *Gireoudia* (Kl.) A. DC., sect. *Weilbachia* (Kl. & Oerst.) A. DC., and sect. *Knesebeckia* (Kl.) A. DC.

1. *BEGONIA WILBURI* Burt-Utley and Utley, sp. nov. TYPE. COSTA RICA. San José. Ca 26 km S of La Georgia on Interamerican Hwy to San Isidro de El General, 1600–1800 m, 19 Oct 1974, J. Utley & K. Utley 1470 ♂ (holotype: DUKE; isotypes: CR, USF). Figure 1.

**Suffrutescent herbs** to at least 1.5 m, frequently branching, potentially dioecious, upper internodes slender, 3.5–7.5 cm, 1.5–4.5(–6) mm diam, densely hirtellous to tomentose with short ferrugineous villi to 0.4 mm. **Stipules** persistent to deciduous, asymmetric, unequal, the larger appearing hemi-ovate to hemi-orbicular with an oblique acute apex, 4–5.5 x 8–11 mm, the smaller, oblong to triangular, 1.2–8 x 1–4 mm, apically acute, marginally ciliate and denticulate to serrulate, hirtellous above and beneath with villi to 0.3 mm; petioles 0.7–5.4 cm, densely hirtellous with villi to 0.5 mm; leaf blades oblique or rarely straight, asymmetrically elliptic to oblong, (5.5–)8.5–18+ x

(3.6)–4.8–8.1 cm, basally unequal-sided, apically attenuate-acuminate, marginally doubly ciliate-crenate to doubly ciliate-serrate and serrulate, above and below densely hirtellous; (6)–11 to 14 pinnately nerved on the broad side of the blade. **Staminate inflorescences** appearing subumbelliferous with perhaps occasionally than 2 branches at the lowermost node, 3–10 or more-flowered; peduncles 1–6.7 cm, densely hirtellous with villi to 1 mm; bracts deciduous, elliptic, to 6.5–11 x 3.5–5.5 mm, marginally ciliate-serrulate to ciliate-laciniate. **Pistillate inflorescences** 1-flowered; peduncles (1.5)–3.5–4.5 cm, densely hirtellous with villi to 1 mm; bracts minute, 1–4 mm, apically lobed. **Staminate flowers** with pedicels 6–13 mm, hirtellous; sepals 2, elliptic to ovate, 8.5–13 x 8–10 mm, marginally occasionally ciliate distally, glabrous to pilose, translucent white to white suffused pink; petals 2, narrowly obovate, 7.5–8.5 x 3.5–5.5 mm, translucent white or white mottled pink; stamens 40–59, appearing monadelphous; filaments 1–1.5 mm; anthers narrowly oblong to obovate, 1.5–2 x 0.4–0.6(–0.8) mm. **Pistillate flowers** with pedicels 1–4 mm, densely hirtellous; bracteoles wanting; tepals 5, subequal, ovate, 12.5–15 x 4–10 mm, pilose without, white or white suffused pink; ovaries trilobular with bipartite placentae, 11 mm, densely hirtellous; styles multi-branched to 2 mm; stigmas at tips of stylar branches. **Capsules** with pedicels (5)–8–14 mm; bodies turbinate, unbeaked, 15–20 mm; wings or horns 3, subequal, oblong to obovate, marginally entire to undulate or denticulate distally.

**Etymology.** It is a great pleasure to name this distinctive species in honor of Dr. Robert L. Wilbur at Duke University who collected extensively in Costa Rica and Panama and has been particularly dedicated to their montane floras. Dr. Wilbur devoted much of his career to developing the fine vascular plant collection in the Duke Herbarium. He was a fine dissertation advisor and mentor for my research with Begoniaceae.

**Distribution and habitat.** *Begonia wilburi* occurs at elevations between 1600 m and 3350 m in montane cloud forests and wet secondary forests on steep mountainsides in the Cordillera Talamanca with *Alnus* and other vegetation in Costa Rica and western Panama.

*Begonia wilburi* is characterized by its apparent dioecy and 1-flowered pistillate inflorescences, immediately standing apart from other known Mesoamerican taxa, except occasionally *B. biserrata* in its dioecy (Burt-Utley & McVaugh 2001). While it is unclear if *B. wilburi* is dioecious, branches of specimens examined either had only staminate inflorescences or pistillate inflorescences at each node, and no branches had both staminate and pistillate inflorescences. In all species studied from México and Central America, only the tuberous *B. cebadilloensis* Houghton ex L.B. Sm. & B.G. Schub. was observed with separate staminate and pistillate inflorescences on the same stem or on the same individual (Burt-Utley pers. obs.). Although there are a number of collections of *B. wilburi*, only two examined (*Picado & Gamboa 251*, MO; *Utley & Burt-Utley 9033*, USF) consist of a branch with staminate inflorescence and a branch with pistillate material, and it is unclear if they came from the same individual. It is not surprising that only two collections of *B. wilburi* have both staminate and pistillate material because staminate stems or individuals of this species are inconspicuous when flowering, and this is even more true of pistillate stems with their short peduncles with one flower (Burt-Utley pers. obs.).

*Begonia wilburi* was first collected by Adolph Tonduz in April 1898 ("Herb. Instit. physico-geogr. nat. costaricensis" #12274) and subsequently annotated by C. de Candolle as *B. cooperi* C. DC., a vegetatively similar species. *Begonia wilburi*, however, appears dioecious with "horned" or turbinate capsules and ovaries, an unusual character that immediately places it in the predominantly South American section *Casparya* (Kl.) Warb. Within Central America, the remaining *Begonia* species have ovaries, capsules, or rarely berries with wings and are all monoecious (pers. obs.). The only other species in this section known from Costa Rica and Panama is *B. urticae* L. f. and *B. wilburi* is easily separated from it by vegetative and floral characters, including its larger leaf blades



Figure 1. *Begonia wilburii*. Isotype (Utley & Utley 1470, USF).

[(5.5–)8.5–18 x (3.6–)4.8–8 cm vs. 0.9–7.5 x 0.5–3 cm], its dioecy, larger staminate sepals (8.5–13 x 8–10 mm vs. 3–5 x 3–4 mm), more numerous stamens (40–59 vs. 5–16), and unbeaked ovaries and capsules.

*Begonia wilburi* appears most closely related to the Colombian endemic, *B. ursina* L.B. Sm. & B.G. Schub., described from fragments, which also is presumably dioecious, with similar few-flowered male inflorescences and one-flowered female inflorescences on separate stems. Moreover, both species are reported from a high elevations (3100 m) and have hirsute to hirtellous stems, leaves, sepals, petals, tepals, and ovaries (pers. obs.; L.B. Sm. & B.G. Schub. 1946). Leaf blades of *B. wilburi* are larger than those of *B. ursina* [(5.5–)8.5–18+ x (3.6–)4.8–8.1 cm vs. 5–5.7 x 1.6–2.4 cm]. Stipules also differ in form between these two species, with those of *B. wilburi* having two different shapes at each node (the larger hemiorbicular and the smaller oblong to triangular) while those of *B. ursina* are ovate. Bracts are large and elliptic in staminate inflorescences (6.5–11 x 3.5–5.5 mm) of *B. wilburi* but much smaller to minute (1–4 mm) in their pistillate inflorescences. In *B. ursina*, staminate bracts are described as ovate (10 mm), and apparently are equal in size to the “bracteoles” of its pistillate flowers. It seems very likely that the authors actually were describing the pistillate bracts of *B. ursina* rather than bracteoles. *Begonia wilburi* is also distinguished from *B. ursina* in its subequal 5-tepaled pistillate flowers, in contrast to the 6-tepaled pistillate flowers of *B. ursina* with three subequal outer tepals and three smaller inner subequal tepals. Six-tepaled pistillate flowers are not unique to *B. ursina* and have been observed in other species in sect. *Casparya* (L.B. Sm. & B.G. Schub. 1946). While both species have unbeaked capsules, the horns of *B. wilburi* are straight, broad, and oblong to obovate, in contrast to those of *B. ursina* which are narrow and falcate.

**Specimens examined.** COSTA RICA. San José. Bords du Río de la Mala, Via au Copey, Apr 1898, *Tonduz* 12274 ♂ (CR); Cantón Perez Zeledon, P.N. Chirripó, cordillera de Talamanca, sendero al Mirador, 9°33'20" N, 83°40'15" W, 18 Aug 1995, *Picado & Gamboa* 251 (♂ & ♀ MO, ♂ USF); Cantón Perez Zeledon, 1 km de Division a la par de Carr. Interamericana, 9 Dec 1996, *Hammel & Hodel* 20575 (MO); slopes of Cordillera de Talamanca near la Division, N of San Isidro de El General, 6 Feb 1963, *Williams, Jiménez M., & Williams* 24385 ♂ (F). 10.8 km S of La Georgina on Interamerican Hwy to San Isidro, 25 Jun 1995, 8000 ft, *Utley & Utley* 9031 ♂ (USF); 9.8 km S of La Georgina, 25 Jun 1995, 8000 ft, *Utley & Utley* 9033 (♂ MO, US, ♂ & ♀ USF). **Puntarenas.** N of San Isidro del General, 12 Aug 1971, 7000–11000 ft, *Vaughan, Dwyer, Spellman, & Wunderlin* 679 ♂ (MO). **PANAMA.** Chiriquí. Vic. of Cerro Punta, 0.5 mi SE of Entre Ríos, 1 mi by rd from town of Cerro Punta, 25 Nov 1979, 2000 m, *Croat* 48573 ♀ (MO); Volcán Barú (E slope), deep draw W of Finca Yen, 17 Mar 1979, 8000 ft, *Hammel, D'Arcy, & Averett* 6452 (MO).

**2. BEGONIA GENTRYI** Burt-Utley & Utley, sp. nov. **TYPE.** COLOMBIA. Chocó. Alto de Buey, 500–1200 m, 8 Jan 1973, *A. Gentry & E. Forero* 7262 (holotype MO; isotypes MO, US). **Figure 2.**

**Rhizomatous herbs;** internodes very short, to 9 mm, 7–9.5 mm diam, glandular and villous-squamous with trichomes 2–4(–6) mm. **Stipules** apparently persistent, narrowly triangular, 13–21 x 3–9 mm, marginally entire, villous, strongly keeled, with the keel fimbriate-laciniate; petioles 9–21 cm, villous with stout trichomes 2–5 mm intermixed with minute glandular hairs; leaf blades asymmetric, oblique to transversely elliptic, reniform or ovate, 12–28 x 8.5–19 cm, basally cordate, apically acute to short acuminate, marginally ciliate and somewhat undulate, glabrous to minutely glandular above and glandular to very sparingly villous below, especially on nerves, with trichomes 0.3–2 mm; 10–12-palmatinerved. **Inflorescences** asymmetrically cymose, greatly exceeding the foliage, ca 14-flowered; peduncles 40–70 cm, sparingly villous with trichomes 1.5–6 mm; bracts caducous, oblong-elliptic, 20 x 11–12 mm, apically truncate, marginally entire. **Staminate flowers** with pedicels (11–)15–20 mm, glabrous; sepals 2, suborbicular to broadly oblong, 11–14 x 13–14 mm, glabrous, light orange; petals 2, obovate, 10–12 x 7 mm; stamens 25–32; filaments appearing free, less than 0.1 mm; anthers elliptic to obovate, 2–2.2 x 0.4–0.6 mm. **Pistillate flowers** with pedicels 12–13 mm, glabrous; bracteoles wanting; sepals 2, transversely elliptic, 11–15 x 10–14 mm, glabrous, light orange; petals 2, obovate, 10 x 8 mm; ovary trilobular with bipartite placentae, 6–6.5

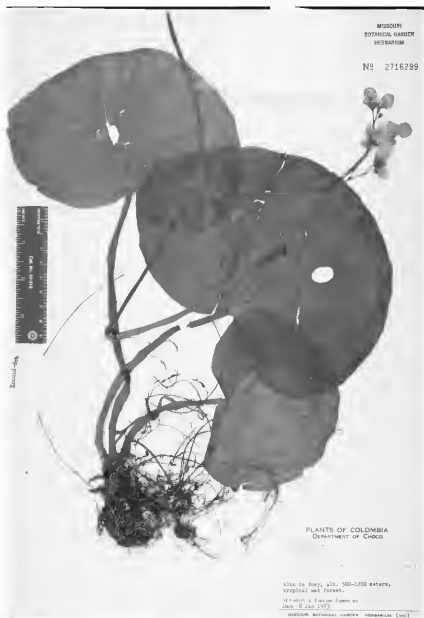


Figure 2. *Begonia gentryi* Holotype (Gentry & Foreiro 7262, MO)



mm, glabrous to sparingly glandular; styles 1.7–2 mm, free to the base; stigmas bicornute. Capsules with pedicels 19–27 mm; bodies 9–11 mm; locule chambers externally appearing broadly ovate, 7.5–8.5 x 6.5–8 mm; wings 3, unequal, the largest wing ovate to elliptic, 19–23 x (9–)13–18 mm, apically rounded to subacute, the other 2 marginiform and triangular to lunate.

**Etymology.** *Begonia gentryi* is named in honor of the late Dr. Alwyn H. Gentry (1945–1993), who was a Curator at the Missouri Botanical Garden before his untimely death in an airplane crash in Ecuador.

**Distribution and habitat.** *Begonia gentryi* is known from the Chocó in Colombia in tropical wet forests at elevations between 500 and 1200 m and has been collected in the Darién in Panama. According to Whiteford and Eddy, *B. gentryi* is common above 900 m in the Serranía de Jungorodo in Panama.

*Begonia gentryi* is distinguished by its rhizomatous habit, eciliate leaf margins, and pistillate flowers with two sepals and two petals. It is one of about four rhizomatous species occurring in Colombia and is readily distinguished from them by its staminate and pistillate flowers consistently with two sepals and two petals, in contrast to two of the remaining three species that have apetalous flowers (*B. nelumbitifolia* Schlecht. & Cham. and *B. urophylla* Hook.) and *B. sericoneura* Liebm. with apetalous staminate flowers but pistillate flowers that are either apetalous or have a single petal (Burt-Utley 1985). *Begonia gentryi* stands apart from known Mesoamerican rhizomatous taxa in its orange pistillate and staminate flowers and, with the exception of *B. mucronistipula* C. DC., pistillate flowers with two sepals and two petals. Flowers of species from the region of the Flora characteristically have sepals, petals, or tepals that range from white to deep pink or rarely yellow-green (Burt-Utley, pers. obs.). *Begonia gentryi* is also notable for the small but conspicuous cystospheres, which are evident on all plant parts except the petals and roots. It appears most closely related to the Panamanian endemic, *B. mucronistipula*, with which it shares its rhizomatous habit and similar pistillate flowers (Burt-Utley & Utley 2011). Other rhizomatous Central American taxa have pistillate flowers that are apetalous or have one petal or five subequal tepals. *Begonia gentryi* is readily distinguished from *B. mucronistipula* by a number of characters, including its internodes with a villous-squamous indument (vs. glabrous), villous stipules and petioles (vs. glabrous), larger anthers (2–2.5 mm vs. 1–1.6 mm), and its large primary wings [19–23 x (9–)13–18 mm vs. (11–)15–17 x 7–9.5 mm]. *Begonia gentryi* also occurs in tropical wet forests at a lower elevations than those reported for the montane *B. mucronistipula* (500–1200 m vs. 1500–2100 m). Although *B. gentryi* shares characters with *B. mucronistipula*, which was tentatively included in sect. *Gireoudia* (Doorenbos et al. 1998), the sectional affiliations of both species are unclear (pers. obs.).

**Additional specimens examined.** PANAMA. Darién. Serranía de Jungorodo, Mamey, 900 m, 10 Mar 1982, Whiteford & Eddy 460 (BM). COLOMBIA. Chocó. S ridge of Cerro Mecana, 6°16'N, 77°18'W, 500–700 m 7 Jan 1984, Juncosa 1758 (MO, USF); Río Mutatá ca 3 km above its junction with Río El Valle NW of Alto de Buey, 850 m, 7 Feb 1971, Lellinger & de la Sota 182 (US).

3. *BEGONIA LIESNERI* Burt-Utley & Utley, sp. nov. TYPE. COSTA RICA. Cartago. Cerro Doán, 3 km E of Cachi, 23 Apr 1969, R.W. Lent 1601 (holotype: F; isotypes: NY, US). Figure 3.

**Suffrutescent herbs** to 80 cm tall; upper internodes (1.5–)4–6 cm, 2–4 mm diam, glabrous, cystospheres abundant. **Stipules** deciduous, asymmetrically ovate to oblong-ovate, 15–18 x 7–8 mm, marginally entire, glabrous, keeled, with only the keel villous; petioles 1.5–3.5 cm, glabrous to very sparingly villous, with the stout villi 0.1–0.7 mm; leaf blades straight to weakly arcuate, asymmetrically narrowly elliptic to ovate, 7–13 x 1.8–4.3 cm, basally unequally sided, apically

attenuate-acuminate, marginally ciliate-serrulate and ciliate-serrate, glabrous throughout above, villous beneath only on principal nerves with stout villi to 0.7 mm; (10-)12-15 pinnately nerved on the broad side of the blade. **Inflorescences** shorter than the leaves, laxly cymose, ca +/- 7-flowered; peduncles 3.5-6.5 cm, glabrous to villous with few villi to 0.7 mm; bracts deciduous, ovate to obovate, 9-12 x 5-7 mm, marginally serrulate, glabrous to sparingly villous, keeled, or the keel only villous. **Staminate flowers** with pedicels 10-15 mm, sparingly short villous; sepals 2, ovate to oblong or elliptic, 9-16 x 6-9.5 mm, glabrous to glandular and sparingly short villous; petals 2, obovate, 9-13.5 x 4.5-6.5 mm, distally shallowly lobed, glabrous; stamens +/- 23, appearing somewhat monadelphous; filaments 0.8-1.3 mm; anthers narrowly obovate to elliptic, 1.8-2 x 0.5-0.7 mm. **Pistillate flowers** with pedicels to 15 mm, villous; bracteoles present, deciduous, obovate, 8-9 x 6-7 mm, apically ciliate-laciniate, marginally ciliate-serrulate, sparingly villous; sepals at anthesis unknown; petals/tepals unknown; ovary trilobular with bipartite placentae, 8-10 mm, hirtellous and minutely glandular; styles and stigmas unknown. **Capsules** with pedicels to 24 mm; bodies 11-14 mm; externally locule chambers elliptic, 8-11 x 6-7 mm; wings subequal to unequal, the largest one asymmetrically triangular, 5-12 x 11-15 mm, the others asymmetrically triangular.

**Etymology.** *Begonia liesneri* is named in honor of Mr. Ronald Liesner at the Missouri Botanical Garden, who first recognized this as a new species.

**Distribution and habitat.** *Begonia liesneri* is known only from Cartago Province where it occurs in cloud forests or rainforests at bases of cliffs between 1400 and 1450 m.

*Begonia liesneri* is characterized by a suite of characters including its suffrutescent habit, glabrous internodes, pinnately nerved leaf blades, large bracteoles, ca 7-flowered inflorescences, and large capsules with subequal to unequal capsule wings. With its several-flowered inflorescences that are shorter than the foliage, *B. liesneri* is potentially an inconspicuous component of the vegetation and easily overlooked by collectors. Without pistillate flowers available, it is difficult to determine the relationships of *B. liesneri* with other Central American taxa because caulescent species with similar staminate flowers could have pistillate flowers with two sepals and one or two petals or four to five subequal tepals (Burt-Utley, pers. obs.). *Begonia liesneri* is distinguished from suffrutescent, pinnately nerved *Begonia* species found in Costa Rica by its several-flowered inflorescences, large, marginally serrulate bracts, and, in all but *B. tonduzii* C. DC., its subequal capsule wings. With the exceptions of *B. tonduzii*, *B. wilburi* (described herein), and the Costa Rican endemic *B. cooperi* C. DC., it is the only other pinnately nerved, pubescent, suffrutescent taxon from Central America (pers. obs.). From *B. tonduzii* it is readily distinguished by its larger bracts [9-12 x 5-7 mm vs. 1.3-3(-5) x 1-3(-4) mm], larger staminate sepals (9-16 x 5-10.5 mm vs. 5-10.5 x 4.5-9 mm), and larger capsules (11-14 mm vs. 6-11 mm) (Burt-Utley, pers. obs.). It differs from *B. cooperi* C. DC. in its much larger staminate sepals [9-16 x 6-9.5 mm vs. (3-4-6(-8) x 3.5-5(-8) mm], large, conspicuously bracteolate pistillate flowers (vs. ebracteolate), persistent petals, and larger capsules [11-14 mm vs. (4-)6-8.5 (-9.5) mm] (Burt-Utley, pers. obs.). The only other pinnately nerved suffrutescent species bearing several flowers is *B. wilburi*, but *B. liesneri* differs immediately from this potentially dioecious species in its monoecy and non-turbinate capsules.

**Additional specimens examined.** COSTARICA. Cartago. Tapanti, Orosi, 1400 m, 29 Jan 1983, I. A. Chacón 259 (USF).



Figure 3. *Begonia hendersonii* Holotype (Lent 1601, F)

4. *BEGONIA MCPHERSONII* Burt-Utley & Utley, sp. nov. TYPE. PANAMA. Bocas del Toro.

Vic. of Cerro Colorado mine above San Felix, trails N of road on continental divide, 8°35'N, 81°50'W, 1500 m, 26 Jan 1988, G. McPherson 12019 (holotype: MO; isotypes: PMA, USF). Figure 4.

**Rhizomatous herbs**; internodes 0.5–1.6 cm, 0.4–1.3 cm diam, lanate with fine sericeous trichomes 1.5–5 mm. **Stipules** persistent, coriaceous, asymmetrically ovate, 1.2–2.7 x 1–1.1+ cm, marginally entire, glabrous keeled, or the keel only pilose, cystospheres abundant; petioles (10.5–)13–23 cm, tomentose with fine sericeous villi 1.5–4 mm; leaf blades oblique to transverse, symmetric to asymmetric, elliptic to oblong in outline, 10.5–18 x 8–17.5 cm, basally cordate, apically with no distinct apex, marginally ciliate-serrate and ciliate-serrulate, deeply asymmetrically palmately lobed usually with 4 to 5 major attenuate-acuminate lobes to ½ the blade length, sparingly pilose above especially above the petiole-blade junction, lanate on primary nerves below but pubescence less dense in intercostal regions; 10–11-palmatinerved. **Inflorescences** greatly exceeding the foliage, weakly asymmetric, densely to laxly cymose with elongate branches, many-flowered; peduncles (21–)30–49 cm, lanate to pilose; bracts caducous, the lowermost apparently completely encircling the inner in bud, subequal, broadly navicular, broadly ovate, 1.7 x 1.4 cm, pilose, cystospheres abundant. **Staminate flowers** with pedicels 9–10.5 mm, pilose; sepals ovate, 5–7 x 7–9 mm, pilose, pink-white; petals 0–2, narrowly obovate to ovate, 4.5–6 x 1.2–1.5 mm; stamens 23–35; filaments 0.5–0.8 mm, on a raised torus and appearing somewhat monadelphous; anthers obovate to elliptic, 1–1.4 x 0.4–0.5 mm. **Pistillate flowers** with pedicels 6–8 mm, pilose; bracteoles wanting; sepals suborbicular to transversely broadly elliptic, (5.5–)8–9 x 8–9.5 mm, pilose, pink-white; petals 0–1, obovate, 6 x 2.5–3 mm; ovary trilobular with bipartite placentae, 3.5–4.5 mm, pilose, cystospheres present; styles 3, 1.5–2 mm, connate over ½ their length; stigmas bicornute. **Capsules** with pedicels 13–19 mm; bodies 6–7.5 mm with conspicuous cystospheres; locule chambers externally ovate, 5–6.5 x 3.5–5.5 mm; wings 3, unequal, the largest wing asymmetrically elliptic, 11–14.5 x 8–10.5 mm, the second one asymmetrically triangular, 5–7 x 5–6 mm and the third marginiform.

**Etymology.** It is a pleasure to name this species in honor of Dr. Gordon McPherson at the Missouri Botanical Garden, who collected this species. Gordon was our field companion and guide in Panama when we collected *Begonia* and Bromeliaceae in 1988.

**Distribution.** *Begonia mcphersonii* is known only from the provinces of Bocas del Toro and Chiriqui in Panama near the continental divide between (800–)1200–1500 m.

*Begonia mcphersonii* appears most similar and closely related to other two species in sect. *Gireoudia* (Kl.) A. DC., *B. involucreata* Liebm. and *B. broussonetifolia* A. DC., because of its deeply lobed leaves, tomentose indument, and its lowermost bracts with the outer apparently encircling the inner. This latter character is unusual among Central American *Begonia* and has only been observed in the suffrutescent taxa in sect. *Gireoudia*, *B. involucreata* and *B. broussonetifolia* A. DC. (Burt-Utley 1985). From *B. broussonetifolia*, *B. mcphersonii* is readily distinguished by its rhizomatous habit, shorter and stouter internodes [0.5–1.6 cm, 0.4–1.3 cm diam vs. (0.9–)1.8–4.4 cm, (2–)3–6 mm diam], palmately multilobed blades (4–5 major lobes vs. 1–2 lobes), and longer peduncles [(21–)30–49 cm vs. (14.6–)17.5–27.5(–29) cm]. *Begonia mcphersonii* stands apart from *B. involucreata* in a number of characters including its habit and elongate inflorescence internodes. Upper branches and frequently the lower branches of *B. involucreata* inflorescences are greatly reduced in length, resulting in inflorescences that are strongly congested distally (Burt-Utley 1985). Because of these differences in branch length, there are conspicuous differences in pedicel length between these two species. Pedicels of staminate flowers, pistillate flowers, and capsules of *B. mcphersonii* are much shorter than those of *B. involucreata* [♂: 9–10.5 mm vs. (9–)12–23 mm; ♀: 6–8 mm vs. (6–)16–25 mm(–30) mm; capsules: 13–19 mm vs. (15–)21–36(–60) mm].



Figure 4. *Begonia mcphersonii*. Holotype (McPherson 12019, MO)

**Additional specimens examined.** PANAMA. Chiriquí. Above San Felix on mining rd. 18–27 mi off the Pan Am Hwy above Chame or turnoff to Escopeta, 12 Mar 1976, *T. B. Croat 33075* (MO, USF); vic. of Cerro Colorado mine development, 28 mi above San Felix, 9–10 mi above turnoff to Escopeta, 13 Mar 1978, *Croat 33206* (MO); on rd in vic. of branch in rd. to Cerro Colorado and Escopeta, above Rio San Felix ca 13 mi N of Rio San Felix bridge, 15 Mar 1976, *Croat 33444* (MO).

**5. BEGONIA PSEUDOPELTATA** Burt-Utley & Utley, sp. nov. TYPE. HONDURAS. Lempira.

Trail from old electricity generation plant to Camp Don Tomás ca. "10 straight line" WSW of Gracias, Parque Nacional Celaque, 14°33'N, 88°40'W, 1850 m, 11 Feb 1993, *R. Evans 1154* (holotype: MO; isotype: USF). Figure 5.

**Suffrutescent herbs** with branching stems to 1.5 m tall; upper internodes 1–2.9(–5.3) cm, 4–8 mm diam, sparingly to densely tomentose with uniseriate whiplash trichomes to 4 mm, intermixed with stout multiseriate whiplash trichomes to 8 mm. **Stipules** persistent, asymmetrically oblong to oblong-ovate, 12–14.5 x 7.5–12 mm, apically obtuse to truncate, marginally entire, glabrous to sparingly tomentose, weakly keeled distally with the keel excurrent apically; petioles (0.6–)2.5–9.5 cm, sparingly to densely tomentose with fine sericeous trichomes to 4 mm; leaf blades oblique, asymmetric, ovate to lance-ovate, 1.8–11.8 x 0.6–8.1 cm, basally peltate, apically acuminate to attenuate-acuminate, marginally ciliate-denticulate to ciliate-crenulate and undulate, occasionally dentate at ends of major nerves; sparingly hirsute above, becoming glabrate, sparingly to moderately tomentose below with trichomes most dense on major nerves; 7–9-peltinerved. **Inflorescences** shorter than to exceeding the leaves, symmetric to asymmetric, densely cymose, ca 40 or more-flowered; peduncles 3.8–14.3(–22.5) cm, sparingly to moderately tomentose; bracts deciduous, the lowermost oblong, 4–11 x 2–3 mm, apically ciliate-lacinate, marginally distally ciliate-lacinate, hirsute. **Staminate flowers** with pedicels 6–14 mm; sepals 2, obovate to elliptic, 7–10.5 x 3.5–6.5 mm, glabrous; petals 2, narrowly elliptic to oblanceolate, (4.5–)7.5–8.5 x 1.6–2.8 mm; stamens 7–13; filaments 0.8–2 mm, borne on a raised torus; anthers oblong to oblong-obovate, 1.1–1.7 x 0.6–0.9 mm. **Pistillate flowers** with pedicels (4.5–)9–11 mm; bracteoles wanting; sepals 2, obovate, 7–8 x 4–5.5 mm, glabrous; petals 1, oblanceolate, 5.5–7 x 1.5–2 mm; ovary trilobular with bipartite placentae, 5.5–7.5 mm, glabrous; styles 3, 2–2.5 mm, fused basally; stigmas lunate. **Capsules** with pedicels 11–18 mm; bodies 7–9 mm; locules externally appearing broadly elliptic to suborbicular, 4.5–6.5 x 4–7 mm; wings 3, subequal to somewhat unequal, the largest wing weakly asymmetric, broadly triangular to lunate-triangular, 5–6.5 x 5.5–8 mm, the second and third wings shallowly lunate to asymmetrically triangular.

**Distribution and habitat.** *Begonia pseudopeltata* is known from Guatemala, Honduras, and Nicaragua at elevations between 600 and 2000 m, where it has been collected in mixed pine and hardwood secondary growth.

*Begonia pseudopeltata* is an attractive suffrutescent species with abundant small flowers and capsules. It resembles *B. peltata* Otto & Dietr. in its peltate leaves and is potentially closely related to this taxon. Although *B. peltata* (syn. *B. incana* Lindl.) was included in sect. *Rachia* (Kl.) A. DC., this species was most recently placed in sect. *Gireoudia* (Doorenbos et al. 1998). *Begonia pseudopeltata* is readily distinguished from this latter taxon by its oblong to oblong-ovate stipules (vs. ovate to triangular) and floral characters, including its more narrow staminate sepals (3.5–6.5 mm vs. 7–11 mm), fewer stamens (7–13 vs. 14–27), longer styles (2–2.5 mm vs. 1.3–2 mm), smaller ovaries (5.5–7.5 mm vs. 6.5–12 mm), and smaller capsules (7–9 mm vs. 10.5–18 mm). Although these species share somewhat overlapping distributions, with both occurring in Guatemala and Honduras, *B. pseudopeltata* has not been reported from México and *B. peltata* is not known to occur in Nicaragua. Moreover, there is no evidence that these species have been collected from the same general localities in either Guatemala or Honduras.

Figure 5. *Begonia pseudopeltata*. Isotype (Evans 1154, USF)

**Additional specimens examined.** GUATEMALA. Chiquimula. Cerro Brujo, in vic. of Rio Negro, below Montaña Montenegro, near village of Brujo, 1500–2000 m, 1 Nov 1939, *Steyermark 30937* (F). HONDURAS. Copán. ca Dulce Nombre, 1200 m, 30 Mar 1963, *Molina R. 11748* (F, LL, NY). Lempira. Sendero entre La Planta Eléctrica y las primera casa (abandonada) de Don Tomás Parque Nac. de Celaque, 14°36'N, 88°40'W, 18 Mar 1991, 1800 m, *House 892* (MO, USF); Cuyamel, without further locality, 30 Mar 1923, *Carleton 474* (US). NICARAGUA. Jinotega. Las Alturas de Kilambé, "Filas el Portal" NE del Cerro Kilambé, 13°37'N, 85°40'W, 600–900 m, 26 Mar 1981, *Moreno & Sandino 7594* (MO).

6. *BEGONIA AGUABUENENSIS* Burt-Utley & Utley, sp. nov. TYPE: COSTA RICA. San José. Cantón León Cortés, Z.P. Caraigres, Cuenca del Pirres-Damas, Cerro Caraigres, Falda SE Fila Aguabuena, entre Quebrada Pilas y Quebrada Ceniza, 9°42'45"N, 84°06'21"W, 1000–1200 m, 26 Dec 1996, *J.F. Morales 5945* (holotype: MO). Figure 6.

**Rhizomatous herbs;** internodes short and stout, 0.9–1 cm long, 1.3–1.8 cm diam, squamose with very broad lacerate and lacinate trichomes 3–5 mm. **Stipules** persistent, reflexed and revolute with age, asymmetrically ovate, 13–23 x 9–13 mm, marginally entire, glabrous, strongly keeled with the keel fimbriate; petioles 8.5–18.5+ cm, glabrous except for a ring of lacerate scales 4–5(–6.5) mm just beneath the petiole-blade junction; leaf blades ovate, 14–21 x 6.5–18 cm, apically attenuate-acuminate, basally peltate, marginally ciliate and weakly undulate, but denticulate at ends of major nerves, above glabrous to minutely glandular, below sparingly squamose on major nerves with trichomes 1.5–3 mm, 6–7-peltinerved. **Inflorescences** exceeding the foliage, asymmetrically cymose, many-flowered; bracts caducous, not seen; peduncles 22–59 cm, glabrous. **Staminate flowers** with pedicels 10–12 mm, glabrous; sepals obovate, 5.5–6.5 x 3.5–5.5 mm, glabrous, white-pink; petals wanting; stamens 7–11, borne on a raised torus; filaments 0.3–0.6 mm; anthers obovate, 1.1–1.3 x 0.5–0.7 mm. **Pistillate flowers** with pedicels 6–8 mm, glabrous; bracteoles wanting; sepals 7.5–10 x 5.5–8 mm, glabrous, white-pink; petals wanting; ovaries trilobular with bipartite placentae, 7–8 mm, glabrous; styles 3, 2–2.5 mm; stigmas lunate. **Capsules** with pedicels 8–11 mm; bodies 11–14 mm, locule chambers externally appearing obovate, 9 x 7 mm; wings subequal, the primary wing asymmetrically lunate-triangular, 5–7 x 9–11 mm; the other wings lunate, 4.5–6 x 8–9 mm.

**Distribution and habitat.** *Begonia aguabuenensis* is known only from central Costa Rica in San José province between 1000–1300 m.

*Begonia aguabuenensis* (sect. *Gireoudia* Kl. A. DC.) is distinguished by its stout rhizomes, peltate leaf blades, squamose petioles, apetalous staminate and pistillate flowers, and subequal ovary and capsule wings. It appears most similar to *Begonia manicata* var *peltata* L.B. Sm. & B.G. Schub. from Guatemala. Both taxa share similar rhizomatous habits, leaf blade size, peltate leaf blades, squamose petiolar trichomes, apetalous flowers, staminate sepals within the size observed for *B. manicata* var *peltata*, bracteolate pistillate flowers, and similar capsule size and subequal capsule wings. The petiolar indument of both taxa is squamose, but that of *B. aguabuenensis* is restricted to a band just below the blade, while in *B. manicata* var *peltata* it is distributed throughout the petioles but is most dense just beneath the blade. *Begonia manicata* var *peltata* is known only from its type and one additional collection from Guatemala (Burt-Utley 1985). There are no known collections of *B. manicata* var *peltata* from Honduras or Nicaragua, while *B. aguabuenensis* appears restricted to Costa Rica. Ideally, more collections of *B. manicata* var *peltata* are needed before its synonymy with *Begonia aguabuenensis* is made.

**Additional specimens examined.** COSTA RICA. San José. Cantón de Acosta. Cuenca del Pirris-Damas, Fila Bustamante, Fila Aguabuena, Aserrí, entre Quebrada Chilamate y Quebrada Pilas, camino, 9°43'35" x 84°11'20"W, 1300 m, 12 Dec 1996, *Morales 5921* (MO).





7. *BEGONIA SUKUTENSIS* Burt-Utley & Utley, sp. nov. TYPE: COSTA RICA. Limón. Reserva Indígena Talamanca, Sukut, desembocadura del Río Sukut en el Río Urén, camino al SE hacia Purisqui. 9°24'15"N, 82°58'10 W, 350–550 m, 6 Jul 1989, B. Hammel, I.A. Chacón, & G. Herrera 17750 (holotype: MO; isotype: USF). Figure 7.

**Herbaceous perennials** with stout repent rhizomes; internodes 2–3.8 cm long, 7–1.6 cm diam, densely tomentose with whiplash trichomes 2–3 mm. **Stipules** broadly ovate to ovate-triangular, 18–22 x 14–22+ mm, marginally entire, densely villous or the keel only villous; petioles 25.5–43 cm, minutely glandular and tomentose with whiplash trichomes 1–3 mm; leaf blades oblique, asymmetrically broadly elliptic to oblong or obovate, 24–32 x 18–24 cm, basally cordate with lobes occasionally overlapping, apically acuminate, marginally ciliate, finely denticulate, and occasionally dentate at ends of major nerves; glabrous above except villous above the petiole insertion, villous on nerves below but only sparingly so in intercostal regions; 14–15-palmatinerved. **Inflorescences** exceeding the foliage, asymmetrically cymose, many-flowered; peduncles 1–1.2 m, sparingly pilose with trichomes 0.3–2 mm and minutely glandular; lowermost floral bracts unknown, but the upper convex, marginally entire and villous medially. **Staminate flowers** with pedicels 2–4 mm, villous and glandular; sepals 2, transversely elliptic, 2–5 x 3–3.5 mm, glabrous to very sparingly villous and glandular, cystospheres present, white; petals wanting; stamens on a raised torus and occasionally appearing submonadelphous, 64–75; filaments 0.5–0.7 mm, maroon; anthers broadly ovate to oblong, 0.3–0.7 x 0.30–0.4 mm, connective maroon. **Pistillate flowers** with pedicels 1–4 mm, villous and glandular; sepals 2, broadly transversely elliptic to obovate or suborbicular, 4–6 x 3.5–6 mm, glabrous to sparingly villous and glandular, white, cystospheres present; petals wanting; ovary 2–3 mm, glabrous, cystospheres abundant; styles 3, 0.5–1.2 mm; stigmas bicornute, appearing maroon when dry. **Capsules** with pedicels to 2 mm; bodies often beaked, 4.5–5.5 mm; locule chambers externally appearing suborbicular to broadly ovate, 3–3.5 x 3.5–4 mm; wings 3, unequal, the largest wing asymmetrically ovate, 7–10 x 5–5.5 mm; the other two wings marginiform, lunate to lunate-triangular.

**Etymology.** *Begonia sukutensis* is named for the region where this species was collected, Sukut, Reserva Indígena Talamanca, desembocadura del Río Sukut en el Río Urén.

**Distribution.** *Begonia sukutensis* is known only from the type locality between 350–550 m, but certainly it is expected elsewhere in Costa Rica and possibly Panama in the appropriate environments.

*Begonia sukutensis* stands apart from almost all other Mesoamerican species in sect. *Gireoudia* (Kl.) A. DC. in its very long peduncles, very short pedicels, and very small sepals and capsules. It is also the only species of Mesoamerican *Begonia* that has filaments, anthers, stigmas and styles that appear maroon; in all other species they are yellow (Burt-Utley, pers. obs.). This unique maroon pigmentation also has not been observed in flowers of western South American taxa (Burt-Utley, pers. obs.). The only other taxa in the section in Costa Rica and Panama with sometimes small sepals and submonadelphous stamens like those of *B. sukutensis* are *B. corredorana* C. DC., a suffrutescent species, and the rhizomatous *B. quaternata* Smith & Schubert (Burt-Utley 1985). *Begonia sukutensis* appears most closely related to *B. corredorana* and occurs at similar elevations, but the latter species is found in evergreen forests and cloud forests on Costa Rica's and Panama's Pacific slopes between 20–900 m, while *B. sukutensis* colonizes Costa Rica's Caribbean slopes. Both taxa have similar villous-tomentose pubescence but differ in plant habit (rhizomatous vs. caulescent), stipule form and size, with those of *B. sukutensis* broadly ovate to ovate-triangular 18–22 x 14–22+ mm (vs. lanceolate, 18–25 x 6–8 mm), glabrous adaxial leaf surfaces (vs. hirsute), more numerous leaf blade nerves (14 to 15 vs. 10 to 13), elongate peduncles [to 1.2 m vs. (12–)18–36 cm], more numerous stamens [64–75 vs. 16–41], and its smaller large capsule wings [7–10 x 5–6 mm vs. (12–

)14–19(–22) x (7–)9–11 mm]. From *B. quaternata*, *B. sukutensis* is immediately distinguished by its tomentose petioles (vs. squamose) and its dichotomously branching inflorescences, in contrast to the typically 3–6-branched inflorescences characteristic of *B. quaternata*.



Figure 7 *Begonia sukutensis* Isotype (Hammel, Chacón, & Herrera 17750, USF)

8. *BEGONIA PANAMENSIS* Burt-Utley & Utley, sp. nov. TYPE. PANAMA. Chiriqui. Trail between N fork of Rio Palo Alto and Cerro Pato Macho, 6 km NE of Boquete, 1800–2200 m, 7 Feb 1986, *M. Grayum* 6418 (holotype: MO; isotypes: PMA, USF). Figure 8.

**Herbaceous perennials** with slender rhizomes; internodes short to occasionally elongate, 0.7–2 (–4.2) cm, 4–9 (–14) mm diam, glabrous to very sparingly villous with stout trichomes to 1 mm. **Stipules** caducous to fugacious, ovate to oblong, 11 x 7 mm, marginally entire, glabrous, only rarely very sparingly villous, keeled; petioles (4.5–)11–35 cm, glandular and sparingly pilose at maturity with fine sericeous villi 1–3 (–3.5) mm; leaf blades oblique to transversely elliptic or ovate, (6.5–)9–16.8 x (4–)7.2–11 cm, basally cordate, apically acuminate, marginally ciliate, weakly undulate, glabrous above and sparingly pilose below, especially on major nerves; 10–12-palmatinerved. **Inflorescences** asymmetric, shorter than to exceeding the foliage, ca 8 or fewer-flowered; peduncles (11–)16.5–38 cm, sparingly pilose with trichomes 1–3 mm; bracts caducous, broadly obovate, 17–18 x 20–22 mm, apically retuse, marginally entire, glabrous. **Staminate flowers** with pedicels 23–46 mm, glabrous to very sparingly pilose; sepals often coriaceous when dry, transversely elliptic, 15–21 x 23–30 mm, glabrous to sparingly glandular and pilose proximally; petals wanting; stamens very numerous, in excess of 100; filaments 0.8–3 mm, appearing free or on a slightly raised torus; anthers narrowly oblong to obovate, (1.3–)1.8–2.5 x 0.4–0.7 mm. **Pistillate flowers** with pedicels 10–15 mm, pilose; bractcoles wanting; sepals transversely elliptic, 10–18 x 17–27 mm, glabrous to sparingly glandular or very sparingly pilose; petals wanting; ovaries fleshy, bilocular with bipartite placentae, 11–15 mm, glandular and pilose; styles 3, 4 mm, fused briefly basally; stigmas bicornute. **Capsules** with pedicels 19–27 mm; bodies when dry coriaceous before dehiscence, strongly nutant, weakly to strongly beaked, rarely unbeaked, (15–)17–23 mm; wings 3, unequal, the largest wing oblong, 14–16 x 15–17 mm; the second and third wings lunate-triangular.

**Distribution and habitat.** *Begonia panamensis* occurs in montane rainforests and cloud forests between 1700 and 2300 m. Although all collections are from Panama, it would not be surprising to find *B. panamensis* in adjacent western Costa Rica.

*Begonia panamensis* is a striking rhizomatous species with few flowers and very large sepals. It has the characteristic fleshy, bilocular ovaries and nutant capsules that dehisce only after their outer covering has eroded like other species in sect. *Weilbachia* (Burt-Utley & Utley 1999), a section known only from Central America and México. Only two other species in this section are known to occur in Panama, *B. carletonii* Standl. and *B. vestita* C. DC. *Begonia panamensis* is readily distinguished from these taxa by its apetalous staminate and pistillate flowers, large sepals, and very numerous stamens. *Begonia panamensis* is most similar to *B. copeyana*, a Costa Rican endemic, with which it shares its apetalous flowers, a similar but less dense indument, and bicornute stigmas. However, it stands apart from this latter taxon in both vegetative and floral characters, including its glabrous to very sparingly villous internodes, more numerous primary blade veins (10–12 vs. 7–10), more numerous stamens [100+ vs. 24–33 (–52)], broader staminate sepals (23–30 mm vs. 10.5–20 mm), larger pistillate sepals (10–18 x 17–27 mm vs. 7.5–8 x 10–12 mm), and larger capsules [(15–)17–23 mm vs. 13–16 mm].

**Additional specimens examined.** PANAMA. Chiriqui. E slopes of Cerro Pando, 8°55'N x 82°44' W, 15 Oct 1981, *Knapp* 1666 (USF); 8 km W of Cerro Pando in vicinity of Las Nubes on trail above stream, 11 Feb 1978, *Utley* 5669 (DUKE); Cerro Pate de Macho, ca 5 mi NE of Boquete, on trail to continental divide leading to Finca Serrano, Pacific slopes, 23 Nov 1979, *Croat* 48559 (MO, USF); vicinity of Boquete, Cerro Pate de Macho SW slope, 8° 46'N, 82°25'W, 19 June 1987, *Croat* 66418 (MO, USF); trail to top of Cerro Pate de Macho, 8°40'N, 82°28'W, *Hoover* 557 (MO, USF); end of rd past Palo Alto to Bocas, *Hammel*, *D'Arcy*, & *Averett* 6506 (MO); SE slopes and summit of Cerro Pato Macho, trail from Rio Palo Alto, 4 km NE of Boquete, 27 May 1981, *Sytma*, *Knapp*, &

*Andersson 4975* (MO), Distr. Bugaba, Santa Clara to Cerro Pando, 28 Feb 1985, *van der Werff & Herrera 7180* (MO, USF)



Figure 8. *Begonia paniculata*. Holotype (from *Grayson 6418*, MO).

9. *BEGONIA GRACILOIDES* Burt-Utley & Utley, sp. nov. TYPE. GUATEMALA. Sololá.

Volcán San Pedro, 2150 m, 20 Sep 1971, A. Molina R. & A.R. Molina 26652 (holotype: F; isotype: MICH). Figure 9.

**Monoeious herbs** presumably with underground tubers; leafy stems erect, freely branching, 0.5–1 m tall; often producing clusters of small bulbils 0.4–1.5 mm diam at the nodes; internodes 3.5–8.5 cm, 3–6.5 mm diam, but the slender branches to 1 mm diam, glabrous to minutely sparingly glandular. **Stipules** persistent, asymmetrically broadly ovate, 5.5–8 x 6–9.5 mm, marginally glandular and ciliate-serrulate, glabrous; petioles (0.6–)2.1–6.5 cm, hirtellous with trichomes to 1 mm; lower leaf blades oblique to occasionally straight, asymmetrically ovate to deltoid, 4.4–10.3 x 3–6 cm, basally cordate, apically acute to acuminate, marginally serrate to doubly serrate or dentate, sparingly ciliate, hirtellous above and below; 6–8-palmatinerved; upper leaf blades asymmetric, much reduced in size. **Inflorescences** borne in the axils of upper leaves and terminating the stem, symmetric, 3–7-flowered; peduncles 2.2–3.8 cm, sparingly minutely glandular; bracts deciduous, hemibicircular to obovate, (6–)7–8.5 x 4.5–11 mm, marginally glandular-ciliate-denticulate. **Staminate flowers** with pedicels 13 mm, glabrous to minutely glandular; sepals 2, ovate to elliptic, 19–21 x 11–13 mm, apically acute to acuminate, marginally glandular-serrulate to denticulate or crenulate, glabrous; petals 2, obovate to elliptic, 13 x 8 mm distally glandular-crenulate to denticulate with short stalked glandular hairs; stamens numerous; filaments to 2 mm, appearing monadelphous; anthers obovoid to subglobose, inserted at an angle, 0.8–0.9 mm. **Pistillate flowers** at anthesis unknown: ebracteolate; tepals presumably 5, elliptic to narrowly ovate, marginally glandular-serrulate with short stalked glandular hairs, externally glabrous to minutely glandular; ovaries trilocular with bipartite placentae, 7–10 mm, immediately post-anthesis, glabrous; styles 3, to 1 mm, fused basally; stigmas bicornute. **Capsules** with pedicels to 16–18 mm, glabrous to minutely glandular; bodies 17–18 mm; locules externally elliptic, 14–15 x 7–8 mm; wings 3, unequal, the largest wing asymmetrically triangular, 11–12 x 16 mm, the second and third wings asymmetrically lunate to lunate-triangular.

**Distribution and habitat.** *Begonia graciloides* is known only from Guatemala, where it occurs on moist banks and in thickets between 1800 and 3000 m. This species might actually be distributed more widely but, because it presumably will die back to its tubers after flowering, will not be a conspicuous component of the vegetation during part of the year.

*Begonia graciloides* (sect. *Knesebeckia*) is characterized by its branching, leafy erect stems, bulbils, several-flowered inflorescences, and marginally denticulate to serrulate staminate sepals. Because bulbils have only been observed on tuberous species from México and Central America, their presence in leaf axils of *B. graciloides* strongly suggests that this species also develops from underground tubers like the Mexican endemic *B. gracilis* H.B.K. (pers. obs.). Three other species known from Central America with bulbils are also tuberous, *B. weberlingii* Immsch. (El Salvador and Oaxaca, México), *B. biserrata* Lindl. (Guatemala and Honduras), and *B. ignea* (Kl.) A. DC. (Costa Rica) (pers. obs.). Although the type and paratype of *B. graciloides* were identified previously as *B. gracilis* and the species was illustrated in the Flora of Guatemala (Smith & Schubert 1961), this species differs from *B. gracilis* in several characters including its several-flowered inflorescences. In contrast, those of *B. gracilis* are typically 2-flowered, bearing one staminate and one pistillate flower (Burt-Utley & McVaugh 2001). Moreover, peduncles are longer in *B. graciloides* than they are in *B. gracilis* (2.2–3.8 vs. 0.5–1.5 cm), while inflorescence bracts are deciduous in *B. graciloides* but persistent in *B. gracilis*. In *B. graciloides*, staminate sepals are acute to acuminate and more narrow than those of *B. gracilis* (11–13 mm vs. 15–22 mm) and are conspicuously glandular-ciliate and denticulate, unlike those of *B. gracilis*, which are simply denticulate to crenulate. Capsules of *B. graciloides* are also smaller than those of *B. gracilis* (17–18 mm vs. 17–25 mm). These species also differ in their distributions with *B. graciloides* apparently endemic to Guatemala, while *B. gracilis* is

very widely distributed in México and has been collected in central Oaxaca, but it is unknown from Chiapas.

**Additional specimens examined.** GUATEMALA. **Escuintla.** Volcán Pacaya, 28 Sep 1972, *Molina & Molina* 27652 (F, MICH) **Sololá.** Volcán Tolimán (slopes above San Lucas Tolimán), 13 Jun 1942, *Steyermark* 47605 (F).



Figure 9. *Begonia graciloides* Holotype (*Molina & Molina* 27652, F).

**10. BEGONIA TENUIS** Burt-Utley & Utley, sp. nov. TYPE MEXICO. Chiapas. Cerro del Boquerón, Aug 1913, *C.A. Purpus 6937* (holotype: NY). Figure 10.

Herbs presumably developing from underground tubers annually, leafy stems erect to sprawling, branching weakly distally, 17–40+ cm tall; often producing clusters of small bulbils to 1 mm diam at the nodes; internodes 2.5–7.5 cm, 1–4 mm diam, hirtellous with short villi 0.4–1 mm. Stipules persistent, ascending to spreading, asymmetrically hemiorbicular to broadly ovate, 2–6 x 3.5–7 mm, marginally ciliate-serrulate to ciliate denticulate, sparingly hirtellous; petioles 1.1–4.7 cm, hirtellous with short villous trichomes 0.3–0.5 mm; lower leaf blades asymmetric, obliquely narrowly ovate, 3.3–11 x 1.5–4.5 cm, basally very shallowly cordate to appearing almost cuneate, apically attenuate-acuminate, hirtellous throughout above and beneath but trichomes most dense on major nerves below; 7–8-palmatinerved; upper blades reduced in size. Inflorescences borne in axils of reduced upper leaves and terminal, 1–2 or more-flowered; peduncles 1.1–3.0 cm, sparingly hirtellous; bracts obovate to suborbicular, 2–3 x 3–4 mm, marginally ciliate-denticulate to ciliate serrulate, glabrous to very sparingly hirtellous. Staminate flowers with pedicels 10 mm; sepals ovate, 12–14 x 8–10 mm, marginally ciliate-denticulate to ciliate-serrulate, apparently glabrous; petals 2, elliptic, 12.5–15 x 5.5–7 mm; stamens very numerous, borne on a stout torus, anthers to 1 mm. Pistillate flowers with pedicels to 14–18 mm; bracteoles wanting, tepals 5, variable in shape, elliptic to ovate or obovate, 7.5–13 x 5–8 mm, marginally the outer 3 ciliate-denticulate to ciliate-serrulate, glabrous; ovary 8–10 mm, presumably trilocular with bipartite placentae, glabrous; styles 3, 1–1.3 mm fused briefly basally; stigmas bicornute. Capsules when immature with pedicels to 20 mm; bodies to 1.5 cm; wings 3, apparently subequal.

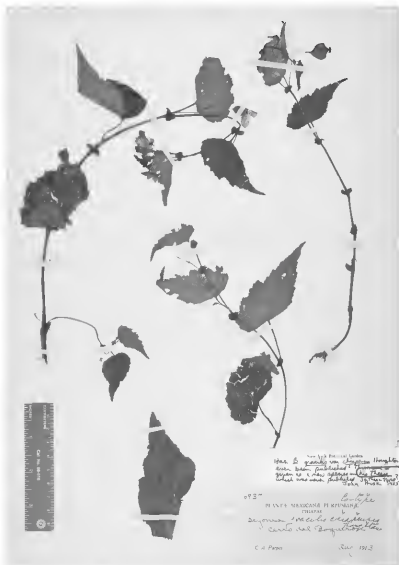
**Etymology.** The specific epithet, *tenuis*, refers to the slender stems of this species.

**Distribution and habitat.** *Begonia tenuis* is known only from eastern Chiapas in México, between 1000–2000 m, but this species should occur in adjacent parts of Guatemala and possibly El Salvador. Like *B. graciloides*, this species would be expected to die back to its tubers after flowering and therefore may not be evident many months of the year.

*Begonia tenuis* (sect. *Knesebeckia*) is characterized by its slender hirtellous stems, bulbils in its leaf axils, hemiorbicular to broadly ovate stipules and ciliate-denticulate to ciliate-serrulate staminate sepals. Like *B. graciloides*, the presence of bulbils strongly suggests that this species also develops from underground tubers, since all species that produce bulbils within México and the region delimited by the Flora Mesoamericana also are tuberous (pers. obs.). In Arthur Houghton's thesis on the Begoniaceae of North America (Houghton 1924), *B. tenuis* was described as *B. gracilis* var. *chiapensis* Houghton, but it was never published. This species is most similar to the tuberous species *B. dealbata* Liebm. (Oaxaca, México, and Guerrero) in its slender habit, and *B. gracilis*, also a Mexican endemic widely distributed through northern, central, and western México. *Begonia tenuis* differs from both *B. dealbata* and *B. gracilis* in its hemiorbicular to broadly ovate stipules, in contrast to the unusual basally cuneate and distally lobed, foliaceous stipules characteristic *B. dealbata* and the ovate to triangular stipules of *B. gracilis*. Ovaries of *B. tenuis* are generally much larger than those of *B. dealbata* (8–10 mm vs. 3.5–7 mm) and smaller than those of *B. gracilis* (8–10 mm vs. 10–21 mm), while *B. tenuis* has subequal capsule wings, unlike the unequal capsule wings of both *B. gracilis* and *B. dealbata* (pers. obs.).

**Additional specimens examined.** MEXICO. Chiapas. Volcán Tacaná, Aug 1938, *Matuda 6039* (LL, MEXU).





## Taxonomic Notes

**BEGONIA MILITARIS** L.B. Sm. & B.G. Schub., Contr. Gray Herb. 154: 24, fig. 2. 1945. **TYPE.** GUATEMALA. Alta Verapaz. Chamá, 270 m, 15 May 1920, *H. Johnson 178* (holotype: US!; isotype: F!).

*Begonia sciadophora* L.B. Sm. & B.G. Schub., Contr. Gray Herb. 161: 28. 1946. **TYPE.**

GUATEMALA. Alta Verapaz. Dense wet limestone forest near Chirriacté on Petén Hwy, ca 900 m, 9 Apr 1941, *P. Standley 91967* (holotype: F!).

*Begonia militaris* is unique among Mesoamerican *Begonia* in having 5-tepaled pistillate flowers with bilocular ovaries. Bracteole form, ovary shape, and the species bipartite placentae were described, and the illustration in Plate II (Smith & Schubert 1945) is clearly of a nutant capsule; however, only bilocular ovaries and nutant capsules without bracteoles or bracteole scars were observed on the specimens examined. These characters together with its creeping rhizomatous habit, pilose petioles, and peltate leaves easily distinguish *B. militaris* from all other Mesoamerican *Begonia* except *B. calderonii* Standl. From *B. calderonii*, *B. militaris* is readily distinguished by its staminate flowers with two sepals and two petals (vs. petals wanting) and pistillate flowers with five tepals (vs. two sepals and no petals). Within México and Central America, other species with bilocular ovaries and nutant capsules have pistillate flowers with two sepals and 0–1 petals, which is characteristic of sect. *Weilbachia* (Burt-Utley & Utley 1999). The affiliation of *B. militaris* with either a section or other species remains unclear. *Begonia sciadophora* is indistinguishable from *B. militaris* in both vegetative and floral characters, including its 5-tepaled pistillate flowers with bilocular ovaries and is synonymized here with *B. militaris*.

**Additional specimens examined.** GUATEMALA. Alta Verapaz. Chapultepec Farm, 62 km from Cobán on Sebol road, 22 May 1964, *Contreras 4763* (DS, US); near Chirriacté on Petén Hwy, 900 m, 9 Apr 1941, *Standley 91953* (F).

**BEGONIA LUDICRA** A. DC., Ann. Sci. Nat. Bot. IV, 11: 133. 1859. **LECTOTYPE** (designated here): MÉXICO. Veracruz. Cordillera, marais de xalapa, 4000 ft, Jun 1840, *Galeotti 189* (G!; isocototypes: BR!, K!, P!).

*Begonia liebmannii* A. DC., Prodr. 15: 345. 1864. **LECTOTYPE** (designated here): MÉXICO. Oaxaca. Tonagüa, Aug 1842, *Liebmann s.n.* (B!; isocototypes: C[2]!).

*Begonia ludicra* was described by A. DC (1859) without the benefit of capsules and included in sect. *Gireoudia*, a section with typically trilocular ovaries. In the Flora of Guatemala (Smith & Schubert 1961), *B. ludicra* was also characterized as having “3-celled” ovaries and nutant to very sharply reflexed capsules. Examination of available collections of *B. ludicra* establish that the pistillate flowers have bilocular, nutant, or reflexed ovaries and capsules that must have their outer coverings erode before dehiscence. These traits are consistent with species in sect. *Weilbachia* (Burt-Utley & Utley 1999) and, with the exception of *B. militaris*, have not been observed in other taxa in from México and Central America.

*Begonia ludicra* has been considered variable in vegetative and floral characters and thought to be distributed from southern México to Guatemala and Panama (Smith & Schubert 1961). However, its description and inclusion in the Flora of Guatemala were based primarily on a vegetatively similar species, *B. purpusii* Ziesenh. Specimens of this latter taxon consistently were misidentified as *B. ludicra*, a species with similar bilocular ovaries and capsules. *Begonia ludicra* is readily distinguished from *B. purpusii* in a number of characters, including its habit and staminate and pistillate flowers. *Begonia ludicra* has rhizomes with short to elongate internodes that root at the nodes and are repent or attached to an upright substrate, where they can form dense masses or mats of

individuals, while *B. purpusii* has elongate stems that may be upright to inclined. *Begonia ludicra* is also distinguished from *B. purpusii* by its staminate flowers with an inner perianth of two petals and pistillate flowers with one petal. In contrast, staminate and pistillate flowers of *B. purpusii* have two sepals and no petals. *Begonia ludicra* is endemic to México, distributed from the states of Veracruz and adjacent Puebla to the wet Caribbean slopes of the Sierra Madre in central Oaxaca, while *B. purpusii* occurs in eastern Chiapas and Guatemala.

**Representative specimens examined.** MÉXICO. Veracruz. Mpio. Huatusco, Ventura, 3 km NE de Huatusco, 1300 m, 31 May 1979, *Avendaño & Benavides M. 301* (F); Mpio. Yecuatla, Lomas de Santa Rita, 3 Jul 1971, *Ventura 3621* (MEXU, MICH); near Jalapa, *Schode 733–734* (B); Jalapa, Jun 1838, *Linden 31* (K, MICH). Puebla. Cascada de Oligui, entre Teziutlán y Tlapacoyan, 1550 m, 2 Jun 1968, *García Saucedo 76* (MEXU). Oaxaca. Mpio. Sta. María Chilchotla, NE de Agua de Gancho, Agencia Municipal María Luisa (8 km del Puente de Fierro, por la terracería a Sta. María Chilchotla, 18°12'21.6" N, 96°49'28.4" W, 1474 m, 8 Jun 2001, *Munn-Estrada & Juárez 1283* (USF); 6 mi S of Puente Nacional on MEX 175 from Tuxtepec to Oaxaca, 2200–2300 ft, 1 Jun 1987, *Utley & Utley 7878* (MEXU, USF); 15.1 mi S of Puente at Valle Nacional or 2 mi N of Vista Hermosa, 4600 ft., 2 Jun 1987, *Utley & Utley 7882* (USF); 3.1 mi N of La Esperanza or 16.1 mi S of bridge at Valle Nacional on Mex 175, 4300 ft, 28 May 1992, *Utley & Utley 8777* (MEXU, USF), Dto. Ixtlán, Puerto San Antonio entre Metates & La Esperanza, 1250 m, 4 Aug 1985 *García M., Lorence, & Allen 1835* (MEXU); 5 km N de Vista Hermosa, km 175 carr. Oaxaca-Tuxtepec, 1260 m, 14 Apr 1982, *Torres C. & Lorence 295* (MEXU).

**BEGONIA PUSTULATA** Liebm., Vid. Meddel. Dansk Naturh. Foren. Kjöbenhavn 1852: 6. 1853. **LECTOTYPE** (designated here): MÉXICO. Oaxaca. Lacoba, Distr. Chinantla, *Liebmman 202* (C!; isotypes: B!, C[2]!).

*Begonia pustulata* is endemic to México, occurring in eastern Veracruz and the lower northern slopes of the Sierra Madre in Oaxaca. Its inclusion in the Flora of Guatemala was based on collections of *B. imperialis* Lem. that were misidentified as *B. pustulata* and illustrated there (Smith & Schubert 1961). This illustration, identified as *B. pustulata*, was used most recently in a synopsis of sect. *Weilbachia* (Doorenbos et al. 1998). *Begonia imperialis* is more widely distributed than *B. pustulata*, ranging from the Isthmus of Tehuantepec to Guatemala between 100 to 1130 m. Although both species have similar bilocular ovaries, they are readily distinguished from each other vegetatively and when in flower. *Begonia pustulata* has larger leaf blades [(7.7)–14–23.3 x (4.6)–8–16.7 cm vs. 5–14(–16) x 3.5–8(–10.6) cm], generally more nerves [(9)–12–14 vs. (8)–9–10 (–11)], and longer peduncles [(8.5)–15–39 cm vs. (4)–6.2–13.5(–17.3)] than *B. imperialis*. Floral characters also separate these species: *B. pustulata* has both staminate and pistillate flowers with two sepals and an inner perianth of petals, while flowers of *B. imperialis* lack petals. Although petals occasionally may abscise from flowers of *B. pustulata*, all specimens examined and populations visited in Oaxaca had flowers with an inner perianth series (Burt-Utley, pers. obs.).

*Begonia faustinoi* Burt-Utley & Utley from Chiapas, México also has been confused with *B. pustulata*, with which it shares certain vegetative and floral characters, including a similar villous indument, staminate and pistillate flowers with both sepals and petals, as well as nutant, bilocular ovaries and capsules. *Begonia pustulata* can be distinguished from *B. faustinoi* by its consistently pustulate or bullate upper leaf surfaces, unlike the even upper surfaces of *B. faustinoi*, as well as its more numerous nerves [(9)–11–14 vs. (8)–9–10(–11)] and longer peduncles [(8.5)–15–39 vs. (4)–6.2–13.5(–15.5) cm] (Burt-Utley & Utley 1999).

**Representative specimens examined.** MÉXICO. Veracruz. Mpio. Catemaco, Dos Amantes entre Catemaco y Sontecomapan, 400 m, 17 Jun 1972, *Beaman & Alvarez del Castillo 6199* (F,

XAL). **Oaxaca.** 6 mi above Valle Nacional on Hwy 175 to Oaxaca, 23 Aug 1977, *Croat 43924* (MO); 17°30'N x 86° 30' W, 100 m, 2 Jul 1981, *Hahn 626* (USF); 5.7 mi S of bridge at Valle Nacional on Mex 175 from Tuxtepec to Oaxaca, 2100 ft, 5 Aug 1987, *Utley & Utley 8042* (MEXU, USF); 5.8 mi S of bridge at Valle Nacional on Mex 175, 2300 ft, 28 May 1992, *Utley & Utley 8775* (MEXU, USF); 6 mi above Valle Nacional on Hwy 175 to Oaxaca, 660 m, 23 Aug 1977, *Croat 43924* (MO); 6.2 mi S of Valle Nacional on Mex 175, 2400 ft, 30 Dec 1985, *Utley & Utley 7525* (USF); 6.2 mi S of Valle Nacional on Mex 175, 2400 ft, 23 Dec 1986, *Utley & Utley 7649* (MEXU, USF); 6.8 mi S of bridge at Valle Nacional on Mex 175 from Tuxtepec to Oaxaca, 2600 ft, 1 Jun 1987, *Utley & Utley 7873* (MEXU, USF); 12 mi S of bridge at Valle Nacional on Mex 175 from Tuxtepec to Oaxaca, 100–200 m N of km 68 marker, 3200 ft, 5 Aug 1987, *Utley & Utley 8038* (MEXU, USF); 4.5 mi N of Vista Hermosa on Mex 175, 3600 ft, 12 July 1982, *Utley & Utley 7046* (USF); near Santiago Zacatepec, 1500 m, 24 May 1939, *Schultes 493* (MEXU).

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# LECTOTYPIFICATION OF *CASTILLEJA BREVIFLORA* A. GRAY NON BENTH. AND ITS IMPORTANCE TO THE NOMENCLATURE OF *CASTILLEJA PUBERULA* RYDB. (OROBANCHACEAE)

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## ABSTRACT

Lectotypification of the illegitimate name *Castilleja breviflora* A. Gray 1862 (non Benth. 1846) is proposed in order to maintain *Castilleja puberula* Rydb. and to resolve the heterotypy of *C. breviflora* A. Gray. *Castilleja breviflora* A. Gray is then formally placed in synonymy under *Castilleja flava* S. Wats.

**KEY WORDS:** Orobanchaceae, Castillejinae, *Castilleja*, *Castilleja brachyantha* Rydb., *Castilleja breviflora* A. Gray, *Castilleja puberula* Rydb., *Castilleja flava* S. Wats., lectotypification, nomenclature, heterotypy

When A. Gray first published *Castilleja breviflora* A. Gray (in 1862), he was unaware that G. Benth. (in 1846) applied this name in *Castilleja* to a species of Andean South America. Rydberg later realized this and in 1900 published the name *Castilleja brachyantha* Rydb. to replace Gray's name. Still later, in 1905, Rydberg described the morphologically similar *Castilleja puberula* Rydb., clearly implying that he regarded the two as different species. Eventually, *C. brachyantha* was reduced to synonymy under *Castilleja flava* S. Wats. by Harrington (1954), while *C. puberula* continues to be recognized as a bona fide species (e.g., Nelson & Harmon 1997; Seagrist & Taylor 1998; Beidleman et al 2000; Hartman & Nelson 2001; Weber & Wittmann 2012). *Castilleja flava* is a widespread species of moderately xeric habitats at middle elevations throughout much of the Intermountain West and is often associated with sagebrush communities. *Castilleja puberula* is an uncommon to rare alpine species endemic to four counties in the central Rocky Mountains of Colorado and likely evolved as a high elevation isolate of *C. flava*.

When Gray established his *Castilleja breviflora*, he cited two elements, Pl. Parry, No. 243 (1861, headwaters of Clear Creek and the alpine ridges lying east of Middle Park, Colorado Territory, duplicates at DUKE!, GH!, IA-ISC!, NY!, P!) and an unpublished T. Nuttall name, "*Euchroma breviflora*, Nutt. in herb. Philad." Based on the known range of the plant in question, Nuttall gathered his specimens in Idaho or Wyoming in 1834. Sheets bearing this name in Nuttall's hand (BM!, PH!) are clearly referable to *C. flava*, while sheets of Parry 243 all bear plants identical to what is now recognized as *C. puberula*. This case of heterotypy complicates the modern usage of the name *C. puberula*, necessitating the lectotypification proposed below.

Based on the fact that only Parry 243 is located at GH and is annotated by Gray as his *Castilleja breviflora*, it is likely the meager description in the protologue was based primarily on the Parry collection (Fig. 1). While most of the description could apply to either *C. flava* or *C. puberula*, Gray does mention that the plants are "spithamea" or only one "hand-span" in height, the typical height of most flowering *C. puberula* plants (Fig. 2) but shorter than most *C. flava* plants of similar development (Fig. 3). However, we know that Gray studied at least the BM specimen of Nuttall s.n., because it bears an annotation in his hand, "*Castilleja. Euchroma breviflora*, Nutt., ined." (Fig. 4). That sheet contains one large, typical stem of *C. flava* but also several, much shorter, poorly

developed or trimmed stems that may have influenced Gray's description as well. Also, according to Pennell (1936) it is likely Gray saw the PH specimen of *Nuttall s.n.*, though it lacks his annotation (Fig. 5).

Until now Gray's *Castilleja breviflora* has not been lectotypified. Apparently, Harrington (1954) was the first to assign *C. brachyantha* to synonymy under *C. flava*, even though that species only partially corresponds to Gray's description of *C. breviflora*. Most authors working with the Rocky Mountain flora later adopted Harrington's synonymy. The islectotype designated below was also annotated as *C. flava* by *Castilleja* authority F.W. Pennell in 1920.

It should be noted that Rydberg's application of *Castilleja brachyantha* is somewhat different from that intended by Gray when he proposed his *C. breviflora*. Aside from linking his new name *C. brachyantha* with Gray's illegitimate *C. breviflora*, Rydberg (1900) cited only a single collection (*P. Koch 10*, Hoodoo Peak, Yellowstone National Park, Wyoming). This collection does not appear to be present at RM at this time, and its true identity has yet to be determined. However, I know of no verified specimens of *C. puberula* from either Montana or Wyoming, and the region in which *Koch 10* was collected is well within the known range of *C. flava* (Holmgren 1984). In Rydberg's works published prior to the description of *C. puberula*, *C. brachyantha* was distinguished from *C. flava* by minor variations in the lower corolla lip. Following the publication of *C. puberula*, Rydberg (1906, 1917) distinguished *C. brachyantha* from both *C. puberula* and *C. flava* based on stature and differences in the structure of the beak and lower lip of the corolla, but his application of the name *C. brachyantha* appears to most closely match plants now treated as *C. flava*.

Typification of Gray's *Castilleja breviflora* with Nuttall's collection will assure that *C. puberula*, a name in current use, will remain available for this rare Rocky Mountain plant, as *C. puberula* was described after both Gray's name and Rydberg's replacement name. This is not a concern with *C. flava*, which was described in 1871, well before Rydberg's *C. brachyantha*.

**CASTILLEJA FLAVA** S. Wats. in King, Rep. Geol. Explor. 40th Parallel [Botany] 5: 230. 1871. TYPE: Utah. [Rich Co.:] Upper Bear River Valley, 7000 ft, Jul 1869, *S. Watson 813* (holotype: GH!, isotypes: NY!, US!, YU!).

*Castilleja breviflora* A. Gray, Amer. J. Sci. 34: 338. 1862. *Castilleja brachyantha* Rydb., Mem. N.Y. Bot. Gard. 1: 360. 1900 (replacement name, not *Castilleja breviflora* Benth. in DC., Prodr. 10: 534. 1846). LECTOTYPE (designated here): USA. [Idaho or Wyoming]. Rocky Mts., 1834, *T. Nuttall s.n.* (BM!, islectotype: PH!).

**CASTILLEJA PUBERULA** Rydb., Bull. Torrey Bot. Club 31: 644. 1905. TYPE: Colorado. "Colorado Territory," 1872, *C.C. Parry s.n.* (holotype: NY!, isotypes: GH!, P!, PH!).

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Figure 1. Mixed sheet at GH containing several collection of *Castilleja puberula*, including both an isotype of *C. puberula* Rydb. and a syntype of *C. breviflora* A. Gray. Note that both my annotation from 1996 and some of those by others are not fully accurate and that only the stems in the lower left obtained by Parry in 1861 actually represent *Parry 243*.





Figure 2 *Castilleja puberula* Rydb., Mt. Goliath Natural Area, Mt. Evans, Clear Creek Co., CO, 11 July 1989, M. Egger 272, WTU





Figure 3. *Castilleja flava* var. *flava*, Angel Lake Road, East Humboldt Range, Elko Co., NV, 27 Jun 1995, M. Egger 688, WTU.





Figure 4. Proposed holotype of *Castilleja breviflora* A. Gray, *Nuttall s.n.*, BM. The collection is of the entity now known as *C. flava* S. Watson. Note Gray's faint annotation in pencil near the bottom edge of the sheet.



Figure 5. Isolectotype of *Castilleja breviflora* A. Gray, *Nuttall s.n.*, PH. The collection is of the entity now known as *C. flava* S. Watson, as annotated in Pennell in 1921.

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**IDENTIFICATION, DISTRIBUTION, AND HABITAT  
OF NEEDLE-LEAVED *HYPERICUM* (HYPERICACEAE)  
IN THE SOUTHEASTERN UNITED STATES**

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**ABSTRACT**

Shrub species of *Hypericum* with needle-like leaves continue to present identification challenges, despite stable taxonomy since the 1960s. Here I provide an improved key, identification notes, habitats, and range maps for nine species of the North American coastal plain.

**KEY WORDS:** *Hypericum*, Hypericaceae, identification, distribution, habitat.

The "needle-leaved" *Hypericum* shrub species have been problematic for two centuries. Many of the species treated in this paper were not recognized or had been synonymized under *H. fasciculatum* Lam. or *H. galioides* Lam. until W.P. Adams' groundbreaking publication (Adams 1962). Prior to then, there was abundant misinformation regarding species limits, morphology, habitat, and distribution. Adams borrowed specimens from 36 herbaria, so there are a large number of correctly identified specimens that serve as a reference base. Nonetheless, botanists continue to have difficulty with the group, in part due to the large percent of incorrectly determined specimens in herbaria. Adams' summary of southeastern USA *Hypericum* (1973) and Robson's treatment of section *Myriandra* (1996) are derivative from the 1962 work and incorporate updated information. Godfrey and Wooten (1981) and Godfrey (1988) made significant improvements to species descriptions and habitat statements; Godfrey (1988) illustrated eight of the nine species. The most recent taxonomic treatment is that of Crockett (2000), which recognizes the same species as Adams (1962).

**METHODS**

The current study was conducted over a period of twenty five years while gathering specimen information on endemic species of the North American coastal plain. Specimens annotated by W.P. Adams served as a baseline for my research, augmented by several iterations of newly constructed keys and my own annotations. I examined specimens at DUKE, FLAS, FSU, GA, GH, MISSA, NCSC, NCU, TEX-LL, USCH, USF, and VDB. Leaf measurements were made of the *longest* leaves on individual plants; normally these occur at branch nodes. Only mature plants were used in this study; sprouts and seedlings produce elliptical, blunt-tipped leaves strikingly divergent from adult plants.

**RESULTS AND DISCUSSION**

**Leaf morphology**

The linear leaves of this group of species are needle-like; that is, they are flattened in cross-section similar to a conifer needle, with the adaxial surface plane. The leaf margins are parallel until the abruptly pointed tip. These species have margins that are termed "revolute" by authors; however, they are revolute to an extreme degree, unlike the normal meaning of the term as "rolled under" or "curved towards the midrib." In this group, margins are abruptly bent under and form an angle with the adaxial surface such that the margins nearly or actually touch the midrib (see illustrations in

Godfrey 1988). Normally, only the midrib and the margins (each with several round punctations) are visible on the abaxial side, with none of the true abaxial leaf surface visible. Moreover, the margins are fused to the abaxial surface, making it virtually impossible to “unroll” the margins. In *H. fasciculatum* and *H. tenuifolium* Pursh (and to a lesser extent in other species) the midrib is raised such that the narrow space between the leaf margins and the midrib forms two elongate grooves. However, these grooves are often very shallow—a situation which has caused some confusion when botanists try to understand what authors mean by “groove” when there appears to be none. In other species, such as *H. nitidum* Lam., *H. brachyphyllum* (Spach) Steudel, and *H. exile* P. Adams, the midrib is slightly raised or not at all, such that the two-grooved aspect is lost; there appears to be a single broad groove or trough with the midrib at the bottom. Note: on any given specimen there may be a few leaves that show a narrow strip of abaxial surface on either side of the midrib; it is not known whether this is caused by pressing/drying or whether it occurs naturally in life. When attempting to identify specimens of needle-leaved *Hypericum*, it is imperative to examine a number of leaves before deciding on morphological characters.

One apparently unrelated species, *Hypericum galioides*, is included in this paper because its normally flat (or slightly revolute) leaves often become strongly revolute in pressing, such that they take on the appearance of needle-leaved species. Slender-leaved populations of the widespread *H. galioides* have been the cause of many misidentifications and misattributions of range within the needle-leaved complex (e.g., Brown & Gandhi 1989). However, in every slender-leaved *H. galioides* specimen examined, many leaves clearly showed the abaxial surface. In addition, leaves of *H. galioides* are oblanceolate or oblinear, contrary to the parallel sides of true members of the needle-leaved complex. Finally, the adaxial surface of the leaves of *H. galioides* is convex, whereas it is plane in *H. brachyphyllum*, *H. fasciculatum*, and other potentially confounding species.

# Plant height

Needle-leaved hypericums conveniently fall into two groups: short species normally less than 0.5 meters tall (*H. lloydii* (Svenson) P. Adams, *H. tenuifolium*) and tall species normally 1–2+ meters tall (*H. chapmanii* P. Adams, *H. fasciculatum*, *H. galioides*, *H. lissophloeus* P. Adams, *H. nitidum*). Two species are intermediate in height: *H. brachyphyllum* ranges from 0.5 to 1.0 m tall, with occasional individuals to 1.5 m (fide Adams 1962 and Godfrey & Wooten 1981); *H. exile* ranges from about 0.4 to 1 m tall, or a bit more.

# Key to the species

In the key I offer more than one character in each couplet, in part because the variability of each species is such that a single character may not distinguish one species from another and in part to facilitate identification whether vegetative, fruiting, or flowering. In the key “nodes” refers to flowers in axillary nodes as well as the terminal cyme.

## 1. Longest leaves 5–16 mm.

2. Adaxial leaf surface convex, merging gradually with revolute margin; leaf shape oblanceolate or linear-oblanceolate ..... *Hypericum galioides*
2. Adaxial leaf surface plane, abruptly angled to revolute portion; leaf shape linear.

3. Capsules 6–9 mm long; longest leaves 5–10(–11) mm; corollas 13–15 mm diameter; plants of spodosol flatwoods and interdunes ..... *Hypericum tenuifolium*
3. Capsules 3–4.5 mm long; longest leaves 7–16 mm; corollas 13–17 mm diameter; plants of alfisols and ultisols of wet pine savannas, flatwoods, seepage bogs ..... *Hypericum brachyphyllum*

1. Longest leaves 13–30 mm.

4. Plant a shrublet or low shrub <4 dm tall, more or less decumbent, forming dense patches; inflorescence elongate (flowers at up to 5 nodes); corollas 10–12 mm diameter; dry to mesic soils of lower piedmont and inner coastal plain of se VA-NC-SC-GA-c AL; disjunct to rock outcrops of s GA ..... ***Hypericum lloydii***

4. Plant an erect shrub 0.5–4 m tall, with single main stem branched above; inflorescence elongate (3–7 nodes) or short (1–3 nodes in *H. fasciculatum* and *H. chapmanii*); corollas 13–26 mm diameter; wet soils of coastal plain.

5. Abaxial surface of most leaves easily seen on both sides of midrib, veins usually obvious on undersurface, leaves oblanceolate to oblinear, (1.0–)1.5–5(–7) mm wide; inflorescence elongate (3–7 nodes) ..... ***Hypericum galioides***

5. Abaxial surface usually not seen except for midrib (leaf margins nearly touch midrib along its whole length), if undersurface visible then no veins visible, leaves linear, needle-like, parallel-sided, 0.5–1.5 mm wide; inflorescence elongate or short.

6. Plant short, <1 m tall; stem <1 cm wide at base; plant unbranched or few-branched, wand-like with narrow crown; restricted to FL panhandle ..... ***Hypericum exile***

6. Plant tall, normally >0.8 m; stem 1–several cm wide at base; crown broader with many ascending to spreading branches.

7. Young branches, leaves, and sepals strongly glaucous; bark of upper stem and branches silvery gray and smooth; mature plant 2–4 m tall with ascending branches imparting tree-like or vase-like aspect; restricted to shores of sinkhole ponds in Bay and Washington cos., FL ..... ***Hypericum fissophloeus***

7. Young branches, leaves, and sepals not glaucous; bark of upper stem and branches not silvery gray and smooth (except some *H. chapmanii*); mature plants variously shaped.

8. Inflorescence elongate (3–7 nodes); stem bark tight, thin, not exfoliating or exfoliating in narrow strips, not revealing buff or pale cinnamon color; if leaf undersurface is exposed it is distinctly paler than upper surface; usually associated with flowing water (blackwater streams and impoundments) ..... ***Hypericum nitidum***

8. Inflorescence short (1–3 nodes). Stem bark corky-thickened to spongy, exfoliating in broad strips or sheets revealing buff or pale cinnamon color; if leaf undersurface is exposed it is about the same color as upper surface; usually associated with static water (Carolina bays, impoundments, beaver ponds, borrow pits, flatwoods depressions, cypress-gum ponds).

9. Mature plant 2–3 (–4) m tall; branches ascending and imparting a tree-like or vase-like aspect (younger plants may be bushy); youngest internodes terete; restricted to flatwoods depressions and cypress-gum ponds of FL panhandle ..... ***Hypericum chapmanii***

9. Mature plant 0.8–1.5 m tall; branches spreading and imparting a bushy or gumdrop aspect; youngest internodes with distinct winged ridge on either side; Carolina bays, impoundments, beaver ponds, borrow pits, widespread ..... ***Hypericum fasciculatum***

# SPECIES NOTES

1. *Hypericum brachyphyllum* (Spach) Steud. is intermediate in stature, but its leaves average shorter than all species except *H. tenuifolium*. North Carolina plants are shorter in height than elsewhere, normally less than 5 dm. Flowers are produced at 3–5 nodes. Unusually tall individuals

may be told from *H. fasciculatum* and *H. nitidum* by characters in the key, plus its later flowering period (July–August vs. late May–early July).

Recently *Hypericum brachyphyllum* has been reported from western Louisiana (Robson 1996; Vernon Par.: Anacoco, *Demaree 50849* (BM). There are specimens at NCU, USF, TEX-LL, and VDB that appear to be this species, collected from more than a dozen sites in eastern Texas and western Louisiana. However, all of these specimens prove to be *H. galioides*, including a duplicate of *Demaree 50849* at NCU. These specimens have unusually slender leaves, but the abaxial side of some to many leaves show exposed leaf surface rather than merely a groove on either side of the midrib. See *H. galioides* text for additional identification criteria. *H. brachyphyllum* inhabits wet pine flatwoods and pitcher plant seepage bogs. Range map 1.

Adams (1962) thought that *Hypericum limosum* Griseb. of western Cuba might be synonymous with *H. brachyphyllum*, but opted to wait for better specimens; Robson (1996) treated *H. limosum* as a good species. I have not seen enough specimens to make an informed decision.

**2. *Hypericum chapmanii*** P. Adams and *H. lissophloeus* are by far the tallest of the group, reaching 3–4 meters. Both usually look like small slender scruffy trees, although some *H. chapmanii* can be as short as *H. fasciculatum* and have a bushy-branched aspect. *Hypericum chapmanii* and *H. fasciculatum* have flowers in a terminal cyme plus 1–2(–3) axillary nodes, unlike the rest of the group, which have flowers in 3–7 nodes. From *H. fasciculatum*, *H. chapmanii* can be distinguished by the greater development of thick corky bark, which has large, vertical, pale lactifers that stand out in contrast to the bark color. From *H. lissophloeus*, *H. chapmanii* can be distinguished by green, non-glaucous leaves (but beware that some *H. lissophloeus* leaves are merely glaucous), smaller flowers (15–16 mm diameter vs. 20–22 mm), and lack of metallic silver-gray color of upper stems and branches (occasional plants of *H. chapmanii* show some of this color).

It inhabits cypress-gum ponds, small lakes, natural depressions, and borrow pits in eleven counties in the Florida panhandle. Range map 2.

**3. *Hypericum exile*** P. Adams has an odd looking gestalt: a wand-like aspect with a few short branches, or unbranched. The sepals and capsules are long (6–7 mm and about 7 mm, respectively, according to Godfrey and Wooten 1981) in contrast with the much shorter sepals and capsules of *H. fasciculatum* and *H. nitidum*. The leaf midrib is pale green or pale greenish tan, unlike the darker color in *H. fasciculatum* and *H. nitidum*. This pale color hardly contrasts with the color of the abaxial surface.

*Hypericum exile* is restricted to five counties in the Florida panhandle, where it inhabits periodically wet flatwoods and savannas. Range map 3.

Robson (1996) treated *Hypericum exile* as *H. nitidum* subsp. *exile* (P. Adams) N. Robson. He also attributes this taxon to western Cuba, citing several specimens. He states that it is more variable in Cuba than in Florida, but gives no data to support his decision to consider Cuban material identical with Florida material. Adams (1962) considered all plants of the *H. fasciculatum* complex occurring in Cuba to be “closest to *H. nitidum*” and places them in *H. nitidum* without additional comment. Adams (1973) repeated this course of action. I have not examined Cuban specimens.

**4. *Hypericum fasciculatum*** Lam., *H. nitidum*, and *H. galioides* have the same gestalt: a single main trunk with many branches forming a roughly rounded crown, long leaves, and wetland habitats. The trunk and oldest branches of *H. fasciculatum* have thickened bark with a spongy or corky texture; the outer layers peel off in thin sheets to reveal a pale cinnamon or pinkish-tan color, in marked contrast



to the bark of *H. nitidum* and *H. galioides*, which is thin and dark and which peels off in small narrow strips or not at all. Although all species of this group of *Hypericum* have fasciated leaves, in *H. fasciculatum* they are generally more numerous and densely packed than in other species; this comparative character can be used with caution in separating vegetative *H. fasciculatum* from *H. nitidum*. Another gestalt character is the more or less cut-off leaves of *H. fasciculatum*, as if someone clipped the fascicles with scissors. The clipped fascicles often give a "neat" appearance to the branches, and expose a good bit of the twig between nodes. Some specimens show this character well; others do not, so caution is advised. Populations in the Sandhills of the Carolinas have shorter leaves on average than elsewhere; otherwise I find no differences among populations rangewide. A crucial character of *H. fasciculatum* is the short inflorescence with flowers at only 1–3 nodes, in marked contrast to all other needle-leaved species except *H. chapmanii*. This inflorescence character becomes critical when other characters of a plant are equivocal.

Pre-Adams determinations of specimens of this and other members of the needle-leaved group were often "*Hypericum fasciculatum*," without recognizing the diversity actually represented. Thus situation contributed to significant errors in range statements and morphology.

*Hypericum fasciculatum* inhabits static wetlands, such as Carolina bays, cypress-gum ponds, natural lakes, impoundments, depressions in flatwoods, borrow pits, and roadside ditches; this is in contrast with *H. nitidum* which see. Occasional populations occur in wet streamheads, cypress stringers, and apparently along blackwater streams (Godfrey & Wooten 1981). Records from western Louisiana and eastern Texas are all misidentifications involving *H. galioides* or *H. brachyphyllum*. Range map 4.

5. *Hypericum galioides* Lam., although not a true member of the needle-leaved group, often produces narrow-leaved forms; in fact, populations west of the Mississippi River almost always produce slender leaves. Leaves of these plants become strongly revolute in drying and many specimens were originally determined as *H. fasciculatum* or *H. nitidum*. However, *H. galioides* can be told by these features: leaves oblanceolate or oblinear (vs. parallel sides), most or all leaves (vs. few or none) showing exposed abaxial surface, abaxial surface usually with obvious venation (vs. none), and elongate inflorescence with flowers at 3–7 nodes (vs. 1–3 in *H. fasciculatum*). Slender-leaved plants of *H. galioides* are vexingly similar to *H. brachyphyllum*, which has similar-sized leaves, corollas, and fruits. From *H. brachyphyllum*, *H. galioides* differs in its linear-oblanceolate leaf shape (slightly broadened distally, vs. linear and with completely parallel sides), in its convex adaxial leaf surface (vs. plane), and in the exposure of abaxial leaf surface in at least several leaves (vs. few or none). Due to its variable size, wide distribution, and broad range of habitats, familiarity with *H. galioides* is fundamental to understanding the true needle-leaved species.

Habitats include ponded depressions, cypress-gum ponds, beaver ponds, impoundments, floodplain swamps, wet savannas, flatwoods, and ditches. Range map 5.

6. *Hypericum lissophloeus* P. Adams is not likely to be confused with any other species, due to its very tall stature (2–4 meters), narrow crown, and tree-like aspect. *Hypericum chapmanii* occasionally produces similar-looking plants, but *H. lissophloeus* differs in its pronounced metallic silver-gray color to upper trunk and limbs, glaucous or glaucescent leaves, and large corollas (at 20–22 mm the largest in the group).

*Hypericum lissophloeus* inhabits sinkhole ponds in deep sand deposits of Bay and Washington Counties, Florida. Range map 6.

7. *Hypericum lloydii* (Svenson) W.P. Adams and *H. tenuifolium* are the only species in the needle-leaved group that normally inhabit dry soils. Moreover, they are the smallest in stature, never exceeding 0.5 m tall. *Hypericum lloydii* is a compact, bushy-branched shrublet. Among the short species of the group (*H. brachyphyllum*, *H. lloydii*, *H. tenuifolium*) *H. lloydii* has the smallest corollas (10–12 mm diameter) and longest leaves (13–25 mm).

*Hypericum lloydii* inhabits dry to mesic roadsides, powerlines, semi-shaded rocky or sandy slopes, and openings in oak-hickory-pine woodlands. Its distribution is unique within the needle-leaved group in that it occupies a narrow band of the lower piedmont and inner coastal plain (Sandhills region). Disjunct populations occur on outcrops of Altamaha Grit sandstone in Turner and Coffee counties in southern Georgia. While numerous in the Carolinas, *H. lloydii* is apparently rare elsewhere. Range map 7.

8. *Hypericum nitidum* Lam. resembles *H. fasciculatum*, with which it has been much confounded, but differs in a number of features. The leaf fascicles never look clipped like those of *H. fasciculatum* and are more widely distributed and expose less of the twig between nodes, thus giving *H. nitidum*'s branches an unkempt appearance. If on a few leaves the abaxial surface may be seen, the surface is much paler than the inrolled margins, in contrast to *H. fasciculatum*. Two excellent characters are the number of flowering nodes (3–7 for *H. nitidum*, 1–3 for *H. fasciculatum*) and dark, thin (not corky) bark that does not flake off in large sheets or strips to reveal a pale cinnamon color as in *H. fasciculatum*.

*Hypericum nitidum* normally inhabits the margins of blackwater rivers, streams, and flatwoods drainageways, in contrast with the usually static waters inhabited by *H. fasciculatum*. On the East Gulf Coastal Plain, *H. nitidum* is often a dominant where blackwater streams meet estuaries (i.e., fresh-tidal zones), in the company of *Sarracenia leucophylla*, *Eriocaulon decangulare*, *Macranthera flammula*, and other seepage bog plants. Locally, *H. nitidum* inhabits borrow pits and roadside ditches.

Reports of *Hypericum nitidum* from Brunswick County, North Carolina (Adams 1962; Godfrey & Wooten 1981) are not supported by vouchers that I have seen and likely pertain to specimens of *H. brachyphyllum*. All "*nitidum*" specimens examined from Louisiana, Mississippi, and from west of Mobile Bay in Alabama prove to be misidentified; thus, *H. nitidum* does not range west of the Alabama-Tensaw River estuary. I have seen one specimen from central Florida: "Salt Springs, Ocala NF", 3 Jun 1929, *Ashe s.n.* (NCU), and S. Crockett (pers. comm.) has seen a specimen from adjacent Lake County. Range map 8.

*Hypericum nitidum* was attributed to Cuba and Belize by Robson (1996), as *H. nitidum* subsp. *cubense* (Turcz.) N. Robson. One of the specimens he cited is Howard 5201 (many herbaria). Two duplicates are at NCU. The general aspect of the branches is like *nitidum*—fascicles not dense, leaves without the "clipped" look of *H. fasciculatum*, unkempt appearance, longest leaves up to 16 mm—but other aspects contradict identity with *H. nitidum* (and with *H. exile*): (1) The abaxial leaf surface is barely or not paler than inrolled margins, contra *H. nitidum* and *H. exile*. (2) The inflorescence consists of 1–3 nodes, contra *H. nitidum* and *H. exile* (both with 3–7 nodes). (3) Plants are extremely short for *H. nitidum*: Howard's labels state "low woody herb seldom to 1 1/2 feet." This is short even for *H. exile*. (4) The habitat is dry: Howard's labels state "dry open grassy meadow," in marked contrast with *H. nitidum* and *H. exile*. Based on this admittedly small sample, I am of the opinion that taxon *cubense* does not belong with *H. nitidum*.

9. *Hypericum tenuifolium* Pursh (= *H. reductum* P. Adams) has the shortest leaves of any of the needle-leaved group. Godfrey and Wooten (1981) stated that leaves do not exceed 5 mm, but plants

in the Carolinas routinely have leaves 4–10 mm long. A key character is the long capsule, 6–9 mm, much longer than other short statured species.

In North and South Carolina *Hypericum tenuifolium* inhabits moist to dry sandy flatwoods, sandhills of Carolina bays, and ecotones of depression ponds, southward it also inhabits maritime interdune swales, pine-scrub oak sandhills on inland or “fossil” dunes, and pond ecotones

On the Gulf Coast of Florida there is a gap in distribution between Pasco and Franklin Counties, with the exception of Dixie County. Apparently this gap reflects a lack of dune and sand ridge habitats. Range map 9

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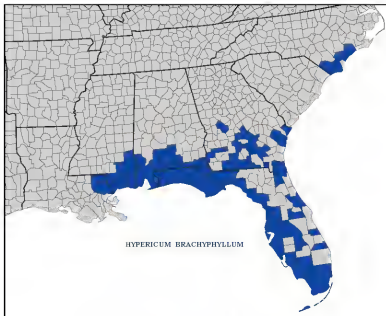


Figure 1. Distribution of *Hypericum brachyphyllum*

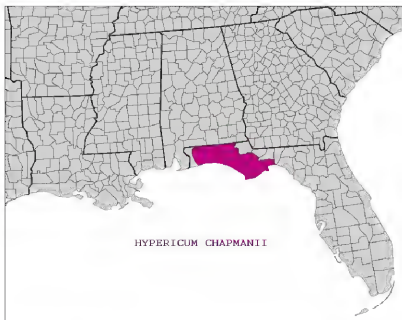


Figure 2 Distribution of *Hypericum chapmanii*

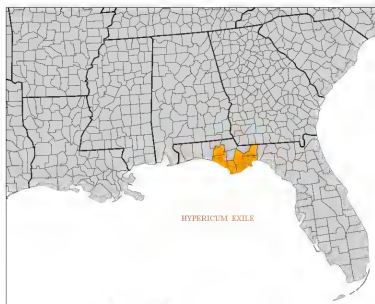


Figure 3 Distribution of *Hypericum exile*

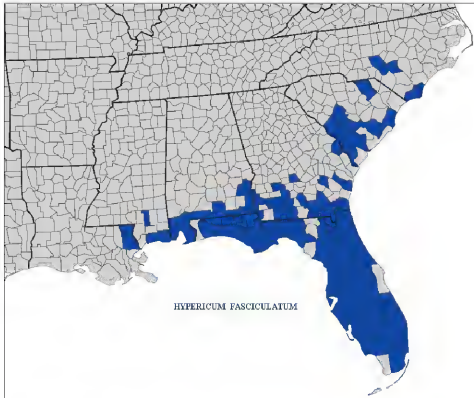


Figure 4 Distribution of *Hypericum fasciculatum*.

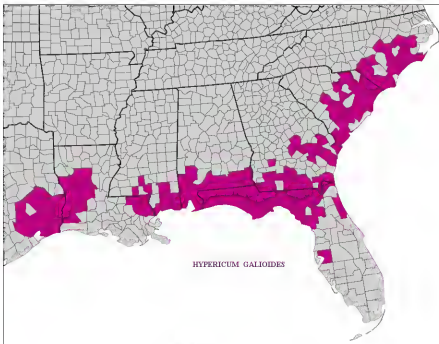


Figure 5 Distribution of *Hypericum galioides*.



Figure 6. Distribution of *Hypericum lissophloeus*

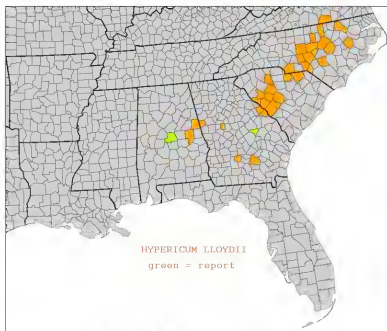


Figure 7. Distribution of *Hypericum lloydii*

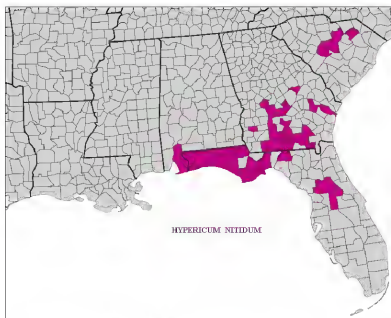


Figure 8. Distribution of *Hypericum nitidum*

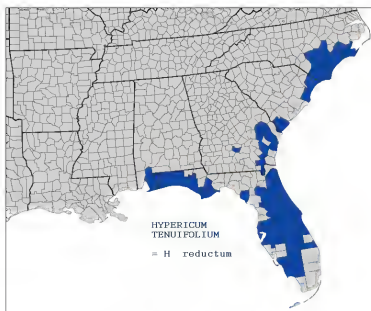


Figure 9. Distribution of *Hypericum tenuifolium*

# APPENDIX 1

## Selected Specimen records

**1. *Hypericum brachyphyllum*.** Alabama. Baldwin Co.: sand dunes, Ft. Morgan peninsula, 28 Jul 1954, *Demaree 59903* (NCU); Conecuh Co.: hillside seepage bog 3–4 mi W of Castleberry, 11 Sep 1989, *Orzell & Bridges 11731* (NCU, TEX); Geneva Co.: pond cypress depression by County Road 4, 12 Sep 1995, *Sortie 8589* (AUA, NCU). Florida. Collier Co.: grassy prairie surrounded by pond cypress swamp, 20 Sep 1965, *Ward 5233* (NCU); Citrus Co.: hardwood swamp, Chassahowitzka, 7 Oct 1972, *Genella & Fleming 1601* (NCU); Duval Co.: near Jacksonville, 3 Jul 1891, *Sudworth 888* (NCU); Wakulla Co.: wetland limestone savanna E of St. Marks Refuge, 14 Sep 1989, *Orzell & Bridges 12099* (TEX). Georgia. Calhoun Co.: edge of low pine woods, 26 May 1961, *Adams 793* (USF); Pierce Co.: borrow pit 0.2 mi N of Alapaha River, 9 Jun 1967, *Bozeman 9404* (NCU); Taylor Co.: Little Whitewater Creek by Georgia 137, 12 Aug 2002, *Kral 93044* (TEX). Louisiana. St. Tammany Par.: roadside ditch S of Talisheek, 20 Oct 1990, *Brown 15023* (TEX); Tangipahoa Par.: near Hammond, 15 Jun 1929, *Ashe s.n.* (TEX). Mississippi. Hancock Co.: acid savanna 1 mi N of Necaise, 6 Jul 1967, *Jones 14122* (USF); Jackson Co.: pine meadows about halfway between Pascagoula and Fontainebleu, 22 Aug 1962, *Harper 4532* (NCU); Wayne Co.: 5 mi N of State Line, low wet grassy flat in open pineland, 18 Jul 1956, *Ray, Jr. 7046* (USF). North Carolina. Brunswick Co.: Camp Branch Savanna, 23 Sep 1994, *LeBlond 4115* (NCU); Columbus Co.: Schulkens Savanna on S.R. 1928, 6 Aug 1994, *LeBlond 3999* (NCU); Onslow Co.: Haws Run Mitigation Site, 14 Jun 2003, *LeBlond 5771* (NCU); Pender Co.: Shaken Creek Savanna, 9 Oct 2002, *LeBlond 5736a* (NCU).

**2. *Hypericum chapmanii*.** Florida. Franklin Co.: shallow ponds near Apalachicola, 1893, *Chapman 5735a* (GH, NCU); Holmes Co.: pond margin near Bonifay, 23 May 1930, *Blanton 6560* (GH); Liberty Co.: *Taxodium ascendens* stringer in wet savanna, 3 mi sw of Kern, Apalachicola National Forest, 1989, *Orzell & Bridges 12061* (GH, NCU); Walton Co.: Grayton Beach, boggy area by stream running into Deer Lake, 31 Jul 1983, *Godfrey 80824* (FSU).

**3. *Hypericum exile*.** Florida. Gulf Co.: 2.5 mi SE of Port St. Joe, pine flatwoods, 18 Jun 1958, *Adams 456* (DUKE, FSU, GH); Liberty Co.: sandy-peaty shallow ditch by forest road 123C, Apalachicola National Forest, 18 Aug 1989, *Godfrey* (GH). Cuba. Prov. Pinar del Rio, *Britton & Crowell 9618* (F, GH, K, MO, NY).

**4. *Hypericum fasciculatum*.** Alabama. Covington Co.: Conecuh National Forest, Forest Service road 96, seepage bog, 12 Jul 1995, *LeBlond 4319* (NCU); Geneva Co.: seepage bog in longleaf pine sandhills W of Geneva, 25 Jul 1968, *Kral 31994* (NCU); Mobile Co.: pine barren flats, hwy 163 between Mobile and Dauphin Island, 3 Jun 1967, *Lelong 3210.1* (NCU). Florida. Alachua Co.: 1 mile E of hwy 24 on 232, 8 May 1965, *Wiggins 20014* (NCU); Hernando Co.: wet prairie, section 11 & 12, 19 Sep 1959, *Cooley 7040* (NCU); Polk Co.: Tiger Creek Preserve, ephemeral pond edges, 28 January 2008, *Corogin TC624* (TEX); Wakulla Co.: wet thickets, January 1929, *Ashe s.n.* (TEX). Georgia. Charlton Co.: powerline right-of-way, east side of Folkston and just north of GA 40, 25 May 1999, *Nelson 20452* (GA, USCH); McIntosh Co.: wet depression along GA 99 S of Eulonia, 20 Oct 1987, *Angerman s.n.* (NCU); Worth Co.: *Cypress-Ilex-Hypericum* pond on Ga. 32, 15 Jun 1967, *Bozeman 9987* (NCU). Louisiana. St. Tammany Par.: wet pine savanna, 11 November 1990, *Urbatsch 6929* (NCU); Washington Par.: wet hardwood forest, 1 Oct 1982, *Taylor 2227* (USF). Mississippi. Forrest Co.: Shelby State Park, 7 Jun 1964, *Jones, Jr. 1864* (NCU); Harrison Co.: De Soto National Forest, Forest Service road 426, seepage bog, 15 Aug 1996, *Sortie 9010* (NCU); Jackson Co.: Orange Grove, 2 May 1954, *Demaree 35057* (GH). North Carolina. Cumberland Co.: wet sandy soil, 15 mi S of Fayetteville, 11 Feb 1940, *Totten s.n.* (NCU); Hoke/Moore Co.: Fort Bragg, boggy margin of Johnsons Millpond, 9 Oct 1991, *Sortie 5967* (NCU). South Carolina. Allendale Co.: swamp 1.2 mi SSW of Barton, 30 Jun 1956, *Bell 4001* (NCU); Berkeley Co.: Francis



Marion National Forest, limesink depression SE of route 654, Jun 1997, *McMillan 2636* (NCU); Orangeburg Co.: Branchville Bay e of US 21, 1 Sep 1994, *Nifong 541* (NCU).

**5. *Hypericum galioides*.** Alabama. Baldwin Co.: low woods bordering Tensaw River, 26 Oct 1967, *Lelong 3868* (NCU); Clarke Co.: low roadside ca. 4 mi N of Choctaw Bluff, 4 Oct 1966, *Clark 9078* (NCU); Washington Co.: stream margin, Bassett's Creek near hwy 43, 3 Oct 1966, *Clark 8716* (NCU). Florida. Columbia Co.: along Fla. 2, halfway between GA state line and Baker County line, roadside ditch in weedy, recently logged pine flatwoods, 11 Jul 1984, *Hansen 10147* (USCH); Levy Co.: highwater mark at edge of floodplain forest, Suwanee River, 22 November 1974, *Godfrey 74133* (NCU); Okaloosa Co.: wet roadside with *Macranthera flammea*, S side hwy 90, 1.8 mi E of 85, 20 Aug 1971, *Musselman 4375* (NCU). Georgia. Brooks Co.: margins of slough on Withlacoochee River, 14 Jul 1965, *Faircloth 2195* (NCU); Chatham Co.: mixed woodland on hwy 21, S of St. Augustine Creek, 14 Jul 1966, *Bozeman 6149* (NCU); Tattnall Co.: cleared floodplain of Altamaha River, NE of Lane's Bridge, hwy 169, 12 Jul 1966, *Bozeman 5923* (NCU). Louisiana. Allen Par.: pine flatwood along hwy 26, 5 mi WNW of Oberlin, 25 Jul 1975, *Allen 6681* (NCU); Calcasieu Par.: moist pine woods, 6 Jul 1950, *Webster & Wilbur 3217* (GA, NCU, TEX); Sabine Co.: pine woods on Peason Ridge Military Reservation, 4 Oct 1980, *Thomas 73842* (TEX); Tangipahoa Par.: wet roadside ditch along LA 1067, 3 mi SW of Robert, 12 Jun 1978, *Allen 8171* (NCU). Mississippi. George Co.: swamp forest along Escatawpa River, hwy 612, 24 Jul 1969, *Lelong 5209* (NCU); Hancock Co.: Mississippi Test Facility (NASA), along canal, 7 Aug 1970, *Rogers 4001-A* (NCU); Lawrence Co.: 3 mi SW of Silver Creek, secondary deciduous wood bordering small stream, foot of pine covered slope, 24 Jun 1957, *Ray, Jr. 8283* (USF). North Carolina. Columbus Co.: low cypress savanna SE of Old Dock, *Leonard 1754* (NCU, TEX); Hoke Co.: Redwing Pond, boggy shrub margin, 21 Jul 2002, *Sorrie 10963* (NCU); Pender Co.: swamp forest on Black River, 3 mi W of Montague, 26 Jul 1953, *Radford 7387* (NCU). South Carolina. Chesterfield Co.: open, savanna-like hillside bog adjacent to Oxpen Lake in Carolina Sandhills NWR, 5 Jul 1985, *Rayner 2324* (USCH); Dorchester Co.: Givhans Ferry State Park, bottomland below marl bluffs, banks of Edisto River, 14 Jun 1988, *Hill 19588* (USCH, USF); Jasper Co.: flatwoods just north of S-94, ca. 1/3 mile E of I-95; NE of Hardeeville, 15 Jul 1984, *Aulbach-Smith 3136* (USCH). Texas. Chambers Co.: freshwater marsh, 1.1 mi S of FM 1985, Anahuac NWR, 14 Jun 2000, *Carr 19031* (TEX); Hardin Co.: cut-over longleaf pine, 5 Sep 1924, *Tharp 3152* (TEX); Montgomery Co.: Lake Houston State Park, utility easement on alluvial terraces, 21 Oct 2003, *Sanders 6261* (TEX); Newton Co.: junction of Big Cow Creek and FM 1416, 24 Sep 2000, *Holmes & Singhurst 11059* (TEX).

**6. *Hypericum lissophloeus*.** Florida. Bay Co.: Lake Merial, 15 mi N of Panama City, 1966, *Ward 5958* (NCU); Washington Co.: in sand along margin and in shallow water of Parish Pond, 8 Jun 1990, *Anderson 12882* (FSU).

**7. *Hypericum lloydii*.** Alabama. Randolph Co.: 2.8 mi SE of Rock Mills, 1.6 mi E of Bacon Level, large relatively undisturbed granite flatrock above Wehadkee Creek and W of quarry, 31 Aug 1985, *Allison 2518* (GA); Tallapoosa Co.: *Harper 3691* (GH, PH, US). Georgia. Coffee Co.: sandstone outcrop on Rocky Creek about 3 mi S of Ocmulgee, 20 Jun 1966, *Bozeman 4591* (NCU); Richmond Co.: Auga, 29 May 1918, *Harbison 14393* (NCU); Turner Co.: Altamaha Grit outcrops, 4 mi N of route 112, 25 Jun 1969, *Faircloth 5855* (NCU). North Carolina. Pitt Co.: no data, 9 Jul 1956, *Boyette s.n.* (NCU); Scotland Co.: margin of sand road through moist pine flatwoods, Sandhills Game Land, 25 Jul 1998, *Sorrie 9875* (NCU); Union Co.: roadside powerline by Austin Road, 12 Jul 2010, *Sorrie 12623* (NCU). South Carolina. Aiken Co.: Graniteville, 1898, *Eggert s.n.* (MO, NY, US); Chesterfield Co.: Sugar Loaf Mountain, 14 Jun 1918, *Coker s.n.* (NCU); Greenwood Co.: roadside bank on rte. 25, 5.3 mi S of Cuffytown Creek, 24 Jun 1987, *Hill 18124* (NCU). Virginia. Mecklenburg Co.: roadside of route 58, 7 Jul 1967, *Seaman 7460* (NCU).

**8. *Hypericum nitidum*.** **Alabama.** Baldwin Co.: *Jack 3004* (GH). **Florida.** Gulf Co.: flatwoods between Panama City and Wewahitchka, 4 May 1926, *Small 12823* (TEX); Marion Co.: Salt Springs, Ocala National Forest, 3 Jun 1929, *Ashe s.n.* (NCU); Santa Rosa Co.: swamp along U.S. 90, Blackwater River e of Milton, 22 November 1966, *Bozeman 8761* (NCU). **Georgia.** Berrien Co.: creek swamp on U.S. 82, E of Enigma, *Bozeman 9932* (NCU); Brooks Co.: road excavation area, 2.8 mi E of Barney, 21 November 1959, *Adams 376* (USF); Dooly Co.: swale in longleaf pineland, *Kral 51607* (TEX); Tattnall Co.: pocosin 1.9 mi NW of Reidsville, 11 Jun 1961, *Ahles 54258* (NCU). **South Carolina.** Darlington Co.: edge of Black Creek near Darlington Country Club, 7 Jul 1940, *Smith 1122* (USCH); Lexington Co.: Black Creek w of Pelion, *Rayner 2569a* (USCH); Richland: Fort Jackson, sand and much of small islands in Colonel's Creek, 16 Jun 1994, *Nelson 15611* (USCH, VDB).

**9. *Hypericum tenuifolium*.** **Alabama.** Baldwin Co.: hwy 182 near Romar Beach, 1 Jun 1977, *Davenport 96* (USF). **Florida.** Lake Co.: dry sand of scrub, Ocala National Forest service road 71, 2 Aug 1962, *Ward 3048* (NCU); Manatee Co.: 1845, *Rugel s.n.* (NCU); Martin Co.: pineland, Jonathan Dickinson State Park, 21 May 1977, *Correll 48587* (NCU); Volusia Co.: scrub near dry pond, road to Benson Spring, 14 April 1953, *Prichard 583* (NCU). **Georgia.** Bryan Co.: fossil dunes, Canoochee River, *Adams 541* (GH, USF); Clinch Co.: low exposed area along rte. 84, 6 mi SW of Homerville, 30 Jun 1998, *McNeithus 98-476* (TEX); Irwin Co.: pine savanna on U.S. 319, 0.7 mile E of Alapaha River, 13 Jun 1967, *Bozeman 9608* (NCU). **North Carolina.** Carteret Co.: recently burned longleaf pine stand about 13 mi W of Morehead City, 9 Jul 1963, *Wilbur 6922* (DUKE, USF); Cumberland Co.: flat pine woods 5.7 mi N of Bladen County line on N.C. 53, 27 Jun 1953, *Ahles 29873* (NCU, USF); New Hanover Co.: Carolina Beach, dry sterile white sand ridge among *Pinus palustris* and *Quercus catesbaei*, *Godfrey, Pl. Exs. Gr. 1260* (GH, NCU, USF). **South Carolina.** Beaufort Co.: Bluffton, 1874, *Mellichamp s.n.* (GH); Horry Co.: savanna, Conway, 1 Sep 1940, *Schallert s.n.* (GH); Jasper Co.: savanna 2.3 mi SW of Ridgeland on U.S. 17, 26 Jun 1956, *Ahles 15529* (NCU).

**NOMENCLATURAL STATUS OF UNRANKED NAMES  
PUBLISHED BY TRELEASE (1911) IN *BEAUCARNEA*, *DASYLLIRION*, AND *NOLINA*  
(ASPARGACEAE-NOLINOIDEAE)**

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**ABSTRACT**

The nomenclatural status of eight infrageneric and five infraspecific names published by Trelease (1911) in *Beaucarnea* Lem., *Dasyllirion* Zucc., and *Nolina* Michx. (Asparagaceae-Nolinoideae) is evaluated. Nearly all later authors treated these names as if they were published at sectional or varietal rank, but they were in fact published without rank assignment. For all names except one, new combinations at sectional or varietal rank were subsequently published by Trelease himself or later authors; these combinations are listed. Typifications for infrageneric names are provided. For one infrageneric name without combination at sectional rank, the new combination *Beaucarnea* sect. *Papillatae* (Trel.) Thiede is proposed.

**KEY WORDS:** Asparagaceae, *Beaucarnea*, *Dasyllirion*, infrageneric classification, new combination, *Nolina*, Nolinaceae, nomenclature, unranked names.

In his treatment of “The desert group Nolineae”, Trelease (1911) published new infrageneric names in *Beaucarnea* Lem., *Dasyllirion* Zucc., and *Nolina* Michx. as well as new infraspecific names in *Dasyllirion* and *Nolina*. Trelease gave a short characterization for all names but did not apply any formal rank to them, so that all names are unranked: e.g., *Beaucarnea* [unranked] *Papillatae* Trel. or *Nolina palmeri* [unranked] *brandegeei* Trel. With the sole exception of Ullrich (1992), virtually all other authors (e.g., Krause 1930; Bogler 1998; Walker 2001; Hess 2002; Hochstätter 2010, 2011; IPNI 2012; Govaerts & al. 2012) wrongly treated Trelease’s names as being published at sectional or varietal rank as, e.g., *Beaucarnea* sect. *Papillatae* Trel. or *Nolina palmeri* var. *brandegeei* Trel.

Three of Trelease’s infrageneric names are invalid according to the autonym rule (see below), whereas all other infrageneric and all infraspecific names are valid but inoperative in questions of priority (Art. 35.3 ICBN, McNeill & al. 2006). Trelease himself and later authors (see below) published new combinations at sectional or varietal rank for all names except one, for which a new combination is proposed here.

In the following, the nomenclatural status of all unranked infrageneric and infraspecific names published by Trelease (1911) in *Beaucarnea*, *Dasyllirion*, and *Nolina* is evaluated, the new combinations based on these names are enumerated, and typifications for all infrageneric names are provided.

**BEAUCARNEA** Lem., Ill. Hort. 8: Misc. 59. 1861). **TYPE:** *Beaucarnea recurvata* Lem.

Trelease (1911) classified the genus into *Beaucarnea* [unranked] *Eubeaucarnea* Trel. (*nom. inval.*) and *Beaucarnea* [unranked] *Papillatae* Trel. For the latter, no combination at infrageneric level was found, so that a new combination at sectional rank is proposed here following ICBN Art. 35.3 & Ex. 4 (McNeill & al. 2006).

**Beaucarnea** sect. **Beaucarnea**. TYPE: *Beaucarnea recurvata* Lem. (= type of *Beaucarnea*). ≡ *Beaucarnea* [unranked] *Eubeaucarnea* Trel., Proc. Amer. Phil. Soc. 50: 427. 1911 (*nom. inval.*, ICBN Arts. 21.3, 22.1 & 22.2; McNeill & al., 2006). TYPE: [not indicated].

Further species: *B. goldmanii* Rose, *B. guatemalensis* Rose, *B. phabilis* (Baker) Rose, *B. sanctomariana* L. Hern.

**Beaucarnea** sect. **Papillatae** (Trel.) Thiede, **comb. nov.** LECTOTYPE (selected here): *Beaucarnea stricta* Lem. ≡ *Beaucarnea* [unranked] *Papillatae* Trel., Proc. Amer. Phil. Soc. 50: 429. 1911. TYPE: [not indicated].

Further species: *B. compacta* L. Hern. & Zamudio, *B. gracilis* Lem., *B. hirtartae* L. Hern.

Hernández-Sandoval (1993, cited in Bogler 1998) suggested that these two sections may not be clearly distinguished.

**DASYLIRION** Zucc., Allg. Gartenzeitung (Otto & Dietrich) 6: 258. 1838. TYPE: *Dasyllirion graminifolium* (Zucc.) Zucc.

Trelease (1911) classified the genus into *Dasyllirion* [unranked] *Eudasyllirion* Trel. (*nom. inval.*) and *Dasyllirion* [unranked] *Quadrangulatae* Trel. In his treatment of the Liliaceae, Krause (1930) cited "*Dasyllirion* Sect. II *Quadrangulatae* Trelease" with full reference including page number from Trelease (1911) which is treated here as valid, albeit unintended, new combination. In his synopsis of *Dasyllirion*, Hochstätter (2011) published an additional sect. *Glaucophyllum*, which accommodates some of the species previously placed in sect. *Dasyllirion*.

**Dasyllirion** sect. **Dasyllirion**. TYPE: *Dasyllirion graminifolium* (Zucc.) Zucc. (= type of *Dasyllirion*). ≡ *Dasyllirion* [unranked] *Eudasyllirion* Trel., Proc. Amer. Phil. Soc. 50: 431. 1911 (*nom. inval.*, ICBN Arts. 21.3, 22.1 & 22.2; McNeill & al. 2006). TYPE: [not indicated].

Further species: *D. acrotrichum* (Schiede) Zucc., *D. gentryi* Bogler, *D. leiophyllum* Engelm. ex Trel., *D. lucidum* Rose, *D. parryanum* Trel., *D. serratifolium* (Karw. ex Schult. & Schult. f.) Zucc., *D. simplex* Trel., *D. texanum* Scheele.

**Dasyllirion** sect. **Quadrangulatae** (Trel.) K. Krause in H.G.A. Engler, Nat. Pflanzenfam. ed. 2, 15a: 356. 1930 [repeated by Ullrich in Kakt. and Sukk. 43(8): centre page pull-out 1992/25. 1992]. ≡ *Dasyllirion* [unranked] *Quadrangulatae* Trel., Proc. Amer. Phil. Soc. 50: 440. 1911. TYPE: *Dasyllirion longissimum* Lem. (typification by inference; only species included).

Further species: *D. miquihuanense* Bogler, *D. quadrangulatum* S. Watson, *D. treleasei* (Bogler) Hochstätter.

**Dasyllirion** sect. **Glaucophyllum** Hochstätter, Pflanze Grasse 31(1): 28. 2011. TYPE: *Dasyllirion glaucophyllum* Hook.

Further species: *D. berlandieri* S. Watson, *D. cedrosanum* Trel., *D. durangense* Trel., *D. longistylum* J.F. Macbr., *D. occidentalis* Bogler ex Hochstätter, *D. palaciosii* Rzed., *D. sereke* Bogler, *D. wheeleri* S. Watson ex Roth.

*NOLINA* Michx., Fl. Bor.-Amer. 1: 207. 1803. TYPE: *Nolina georgiana* Michx.

Trelease (1911) classified the genus into *Nolina* [unranked] *Graminifoliae* Trel. (*nom. inval.*), *N.* [unranked] *Erumpentes* Trel., *N.* [unranked] *Microcarpae* Trel. and *N.* [unranked] *Arborescentes* Trel.

In a synopsis of *Nolina*, Hochstätter (2010) cited these names as being published at sectional rank. Since Hochstätter also cited the full reference including page number from Trelease (1911), Hochstätter's sectional names are treated here as valid, albeit unintended, new combinations.

*Nolina* sect. *Nolina*. TYPE: *Nolina georgiana* Michx. (= type of *Nolina*). ≡ *Nolina* [unranked] *Graminifoliae* Trel., Proc. Amer. Phil. Soc. 50: 413. 1911 (*nom. inval.*, ICBN Art. 22.1; McNeill & al. 2006). TYPE: [not indicated].

Further species: *N. atopocarpa* Bartlett, *N. brittoniana* Nash, *N. humilis* S. Watson, *N. lmdheimeriana* (Scheele) S. Watson, *N. pumila* Rose.

*Nolina* sect. *Erumpentes* (Trel.) Hochstätter, Pianta Grasse 30(Suppl.): 14. 2010. TYPE: *Nolina erumpens* (Torr.) S. Watson. ≡ *Nolina* [unranked] *Erumpentes* Trel., Proc. Amer. Phil. Soc. 50: 416. 1911. TYPE: [not indicated].

Further species: *N. arenicola* Correll, *N. cespitifera* Trel., *N. greeni* S. Watson ex Wootton & Standl., *N. micrantha* I.M. Johnston, *N. texana* S. Watson.

*Nolina* sect. *Microcarpae* (Trel.) Hochstätter, Pianta Grasse 30(Suppl.): 23. 2010. TYPE: *Nolina microcarpa* S. Watson. ≡ *Nolina* [unranked] *Microcarpae* Trel., Proc. Amer. Phil. Soc. 50: 420. 1911. TYPE: [not indicated].

Further species: *N. durangensis* Trel., *N. elegans* Rose, *N. palmeri* S. Watson, *N. rigida* Trel.

Hochstätter (2010: 2) considered *Nolina rigida* as an unclear species.

*Nolina* sect. *Arborescentes* (Trel.) Hochstätter, Pianta Grasse 30(Suppl.): 29. 2010. LECTOTYPE (selected here): *N. longifolia* (Karw. ex Schult. & Schult. f.) Hemsl. ≡ *Nolina* [unranked] *Arborescentes* Trel., Proc. Amer. Phil. Soc. 50: 422. 1911. TYPE: [not indicated].

Further species: *N. azureogladiata* D. Donati, *N. beldingii* Brandegee, *N. bigelovii* (Torr.) S. Watson, *N. cismontana* Dice, *N. hibernica* Hochstätter & D. Donati, *N. interrata* Gentry, *N. juncea* (Zucc.) J.F. Macbr., *N. matapensis* Wiggins, *N. nelsonii* Rose, *N. parryi* S. Watson; *N. parviflora* (Kunth) Hemsl.

Hochstätter (2010: 2) considered *Nolina juncea* as an unclear species.

#### UNRANKED INFRASPECIFIC NAMES

Trelease (1911) published 2 unranked infraspecific names in *Dasyliirion* and 3 in *Nolina*. In an excerpt published the following year (Trelease 1912), Trelease assigned varietal rank to these names which are treated here as valid new combinations.

*Dasyliirion texanum* var. *aberrans* (Trel.) Trel., Feddes Repert. 11: 52. 1912. ≡ *D. texanum* [unranked] *aberrans* Trel., Proc. Amer. Philos. Soc. 50: 434. 1911. Accepted name: *D. texanum* Scheele (Hochstätter 2011, Govaerts & al. 2012).

*Dasyliiron wheeleri* var. *wislizenii* (Trel.) Trel., Feddes Repert. 11: 53. 1912.  $\equiv$  *D. wheeleri* [unranked] *wislizenii* Trel., Proc. Amer. Philos. Soc. 50: 439. 1911. Accepted name: *D. wheeleri* S. Watson ex Rothr. (Walker 2001, Hochstätter 2011, Govaerts & al. 2012).

*Nolina palmeri* var. *brandegeei* (Trel.) Trel., Feddes Repert. 11: 50. 1912.  $\equiv$  *N. palmeri* [unranked] *brandegeei* Trel., Proc. Amer. Philos. Soc. 50: 420. 1911. Accepted name: *N. palmeri* S. Watson (Hochstätter 2010, Govaerts & al. 2012).

*Nolina beldingii* var. *deserticola* (Trel.) Trel., Feddes Repert. 11: 50. 1912.  $\equiv$  *N. beldingii* [unranked] *deserticola* Trel., Proc. Amer. Philos. Soc. 50: 424. 1911. Accepted name: *N. beldingii* Brandegee (Hochstätter 2010, Govaerts & al. 2012).

*Nolina texana* var. *compacta* (Trel.) I.M. Johnst., J. Arnold Arbor. 24: 90. 1943.  $\equiv$  *N. erumpens* var. *compacta* (Trel.) Trel., Feddes Repert. 11: 49. 1912.  $\equiv$  *N. erumpens* [unranked] *compacta* Trel., Proc. Amer. Philos. Soc. 50: 418. 1911. Accepted name: *N. texana* S. Watson (Hess 2002, Hochstätter 2010, Govaerts & al. 2012).

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## CRITICAL TAXA IN *CRATAEGUS* SERIES *MOLLES* (ROSACEAE): TYPIFICATIONS, NEW COMBINATIONS, AND TAXONOMIC REVIEW

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### ABSTRACT

Ten specific or varietal epithets attributed to *Crataegus* series *Molles* are typified or their types commented on. Those typified are *C. arkansana* Sargent, *C. brazoria* Sargent, *C. canadensis* Sargent, *C. coccinea* L. var. *mollis* Torrey & Gray, *C. grvida* Beadle, *C. lanuginosa* Sargent, *C. meridionalis* Sargent, *C. mollis* (Torrey & Gray) Scheele var. *incisifolia* Kruschke, and *C. submollis* Sargent. There is also a minor issue with the type of *Crataegus texana* Buckley, which is commented on. The new combinations *Crataegus mollis* var. *meridionalis* and *C. texana* var. *dasyphylla* are made. This is followed by a taxonomic review of ser. *Molles* with emphasis on the 20-stamen taxa.

**KEY WORDS:** *Crataegus* (Rosaceae) series *Molles*, typifications, taxonomic review, *Crataegus arkansana* Sargent, *C. brazoria* Sargent, *C. canadensis* Sargent, *C. coccinea* L. var. *mollis* Torrey & Gray, *C. dasyphylla*, *C. grvida* Beadle, *C. lanuginosa* Sargent, *C. meridionalis* Sargent, *C. mollis* (Torrey & Gray) Scheele, *C. mollis* var. *incisifolia* Kruschke, *C. submollis* Sargent, *C. texana* Buckley, new combinations, *Crataegus mollis* var. *meridionalis* (Sargent) J.B. Phipps, and *C. texana* var. *dasyphylla* (Sargent) J.B. Phipps

Numerous species in *Crataegus* series *Molles* (Sargent ex C.K. Schneider) Rehder were described around a century ago, primarily by Sargent and Ashe and the relevant epithets were collated by Palmer (1925). Many of these names have never been typified and the present paper rectifies this for most of the critical names. I also present a brief review of the taxa accepted with particular attention to the 20-stamen species *C. mollis*, *C. texana*, and *C. brazoria* in order to support the author's forthcoming treatment of *Crataegus* in *Flora of North America*, Vol. 9. Questions related to the predominantly northern, 10-stamen taxa will be addressed in another paper.

Typification problems are legion and are characteristic of a period when botanists were feeling their way to the more precise notions of holotype and isotype. As most of the names are by Sargent, some familiar issues of interpretation were encountered. For instance, notations of 'type' may be repeated on different specimens, thus they do not automatically imply a holotype. This may even be so when the word 'type' in the protologue is explicitly placed next to a particular date and collection number because duplicates may exist. Likewise the protologue may be ambiguous as to whether a single specimen or 'type tree' is being cited. It is therefore helpful to understand that Sargent's, Beadle's, and even Kruschke's view of 'type' is commonly that of the 'type tree.' In such cases Sargent and his collectors, such as B.F. Bush, often gave the type tree a number separate from the collection number (which varied with date and collector) and this 'type tree' number may be used by various collectors on different dates when collecting from a single marked tree. Beadle, however, usually used different field numbers for collections on different dates and designated 'co-types' commonly from the same tree, while Kruschke used one collection number for all collections of whatever date from the type tree. Label data must be interpreted with this in mind. The type tree concept is very helpful in interpreting these author's taxa, though in the case of Sargent one does need to be aware of occasional apparent discrepancies among specimens having the same number. As

well, Sargent's rather notorious apparent carelessness in citing specimens in the protologue (alternatively viewed as errors in the label) can result in probable syntypes with some element at variance cited with protologue. In addition, there may sometimes be considerable variation among different syntypes, as in *Crataegus gravior* Beadle in this paper. Sargent's protologues are usually more detailed than Beadle's.

A different problem confronting taxonomists of North American *Crataegus* is the difficulty of being absolutely sure of the application of a name, because specimens collected only at one season may not be adequately diagnostic. For this reason, in some cases I designate an epitype collected at another season. The ability to do this is, in fact, aided by the 'type tree' practice as it provides a high level of confidence that flowering and fruiting specimens match.

### ILLUSTRATIONS

This account illustrates all the 20-stamen taxa mentioned plus *Crataegus submollis* and *C. canadensis*. The source materials are herbarium specimens, most of which have been seen by the author. The sources of images are Harvard University (A and GH), Philadelphia Academy of Sciences (PH), Missouri Botanic Garden (MO/Tropicos), New York Botanic Garden (NY), and Royal Ontario Museum (TRT). It should be noted that sometimes only partial sheets are illustrated and thus label data may be omitted from the figures. In such cases, elements are selected are those that are in better condition, that are more typical or to avoid repetition. In doing so composites (from the same sheet) have been created to generate more visually helpful images.

### TYPE DESIGNATIONS

Type designations are arranged alphabetically by species.

***Crataegus arkansana*** Sargent, Bot. Gaz. 31: 223. 1901. **LECTOTYPE** (designated here): USA. Massachusetts. Jamaica Plain (cult.), 18 May 1900, *C.S. Sargent*\* 482-2 (A barcode 18257). Figure 1.

**Comment.** The lectotype is an entirely characteristic, richly flowering, cultivated specimen of the *C. mollis* group with distinctively shaped leaves. It is selected from the syntypes because of its high quality and similarity to the protologue, critically in leaf shape. The lectotype lacks the seed provenance data on the label but I am assured by J. Damery at the Arnold Arboretum (pers. comm.) that the collection number 482-2 does match one for a Letterman specimen of 1883 Arkansas provenance. On the other hand, the fruiting syntype (MASS, cult., collector unnamed 4177, 8.xi.1898, A barcode 18256), although possessing seed provenance data (annotation "from seed lot 484.2 collected by G.W. Letterman, Newport, [Jackson Co.] Ark., in 1883") was rejected as lectotype because it appeared sufficiently different in leaf shape characters, particularly in the lobing, and this casts doubt on it being from the same seed accession. Comparison with Faxon's illustration (tab. 660 in Sargent, 1902) emphasizes this. It is also worth noting that the description of leaf shape in the *Silva* differs slightly from that in the protologue. Also, according to Damery, 484.2 is not a possible number for a Letterman 1883 Arkansas accession.

*Crataegus arkansana* as interpreted here has leaves of an unusual shape for the 20-stamen, ivory-anthered forms of the *C. mollis* complex, these being of a +/- narrow-ovate to ovate form with cuneate bases and having relatively deep and sharp lobes. However, they are somewhat like var. *incisifolia*. Jennifer Ogle (pers. comm.) was not able to turn up any unambiguous *arkansana* types from the holdings at UARK. Recent material from Arkansas, or elsewhere, for that matter, matching the lectotype would therefore be welcome.



\*The label is in Sargent's handwriting but no collector is named, therefore there has to be some doubt as to whether he was the collector.

***Crataegus brazoria*** Sargent, Bot. Gaz. 31: 233. 1901. **LECTOTYPE** (designated here): USA. Texas. Brazoria Co.: Columbia, 25 Mar 1900, *Wm. Canby, C.S. Sargent, Wm. Trelease 102* ("C.n. 3") (DOV 4899; islectotype: GH 21409). Also on same sheet is *B.F. Bush 911* (tree 3) 25 Sep 1901, DOV 4898, with packaged fruit (latter absent from 'photoshopped' image). Figure 2.

**Comment.** The lectotype is an extremely fine specimen with elliptic leaves, sharp marginal teeth and acute lobes reduced to apiculi. It is in full flower and has conspicuous bracteoles. Sargent said that only one tree was known, presumably 'tree 3', found on most syntype labels. The islectotype at Harvard is credited only to Sargent. There is also a vegetative Bush specimen at A (*B.F. Bush 170*, 27 Mar 1900).

***Crataegus canadensis*** Sargent, Bot. Gaz. 31:7. 1901. **LECTOTYPE** (designated here): CANADA: Quebec. Chateauguay, 29 May 1887, *J.G. Jack 79* (A18297). Figure 3.

**Comment.** A flowering specimen was selected for lectotype that clearly showed 20 stamens when imaged. *Crataegus canadensis* has many syntypes.

***Crataegus dasphylla*** Sargent, Ann. Rep. Missouri Bot. Gdn. 22: 80. 1911. **LECTOTYPE**: designated in Phipps et al. (2007). Figure 4.

***Crataegus dumetosa*** Sargent, Ann. Rep. Missouri Bot. Gdn. 19: 109. 1908. **LECTOTYPE**: designated in Phipps et al. (2007). Figure 5.

***Crataegus gravida*** Beadle, Biltmore Bot. Stud. 1(2): 119. 1902 [30 Apr]. **LECTOTYPE** (designated here): USA. Tennessee. Davidson Co.: Nashville, flowering specimen, no date but Beadle says 'early May' in protologue, *T.G. Harbison 2142* (A). Possible islectotype: US 97593, but see comment. Figure 6.

**Comment.** The lectotype at A (label in Beadle's hand) and the putative syntypes, H2142 and H2736 at US (both on the same sheet), are sufficiently dissimilar as to appear to be from different entities. However, one cannot be sure of this and H2142 at both A and US have the rather small (ca. 15 mm) flowers for the species. Beadle described the leaf margins as 'shallowly incised' which seems a truer reflection of the US specimens though I do not understand his limit to 'shallow.' There are a number of specimens from this area at TRT and they lie between the extremes of the syntypes.

As I have observed it, a tallish *mollis*-group *Crataegus* with smallish (3–5 cm), quite strongly lobed short-shoot leaves, proportionately somewhat narrower than any of the type material but more like the A lectotype in lobing, appears to be a characteristic form of *C. mollis* in southeastern woodlands on limestone.

***Crataegus lanuginosa*** Sargent, Trees & Shrubs 1(3): 113, plate 57. 1903. **LECTOTYPE**: designated in Phipps et al. (2007). Figure 7.

***Crataegus meridionalis*** Sargent, J. Arnold Arbor. 1: 252. 1920. **LECTOTYPE** (designated here): USA. Alabama. Hale Co.: Gallion, 17 Apr 1915, *T.G. Harbison 11833* (TENN 3345a; islectotype: A). Figures 8, 9.

Comment. A possible isotype is *T.G. Harbison* 7 (A), same notes as lectotype, except with a tree number rather than a collection number. Also, there are two fruiting syntypes at A.

***Crataegus mollis*** (Torrey & Gray) Scheele, *Linnaea* 21: 569. 1848. *Crataegus coccinea* Linnaeus & *mollis* Torrey & A. Gray, *Fl. N. Amer.* 1: 465. 1840. **LECTOTYPE** (designated here): USA. Ohio. Hamilton Co.: Cincinnati, May, no year, *T.G. Lea s.n.* (NY 532807). Figure 10.

Comment. The lectotype contains a short flowering shoot plus a young extension shoot, plausibly from the same plant. Two syntypes have a mix of fruiting and vegetative shoots apparently also of *Crataegus mollis* but of a different leaf type from the lectotype. The flowering specimen is chosen as lectotype as it is the only specimen reliably referable to the current concept of *C. mollis* var. *mollis* (leaves with shallow subacute to obtuse lobes; ca. 20 stamens in undamaged flowers). The two syntypes, both *A. Clapp s.n.*, have label data “April 20 1839” and “21 May 1839” but are obviously late season and lack provenance.

***Crataegus mollis* var. *incisifolia*** Kruschke ex J.B. Phipps, *J. Bot. Res. Inst. Texas* 1: 1012. 2007. **LECTOTYPE**: designated in Phipps (2007b). Figure 11.

Comment. Figure 11 is a composite from figs. 103-105 in Kruschke (1965), which show specimens made from the type tree at various growth stages. The shape of mature short-shoot leaves (Fig. 11c) is not unlike those of *Crataegus arkansana* (Fig. 1) but the latter lacks the deeply incised extension shoot leaves of the current variety.

***Crataegus submollis*** Sargent, *Bot. Gaz.* 31: 7-9. 1901. **LECTOTYPE** (designated here): USA. Maine. Penobscot Co.: Orono, 27 May 1887, *M.L. Fernald s.n.* (GH 273975). Figures 12, 13.

Comment. The two flowering specimens on GH 273975 are very similar and display large leaves and flowers, very villous inflorescences, and large herbaceous bracteoles. Both GH fruiting syntypes, collected by J.G. Jack from Gerrish I., Maine, have the accrescent sepals characteristic of the series.

***Crataegus texana*** Buckley, *Proc. Acad. Nat. Sci. Philadelphia* 1861: 454. 1862. **TYPE**: USA. Texas. Columbia Co.: along Brazos and Columbia Rivers, common, flowering specimen, without date, *S.B. Buckley s.n.* (holotype: part of PH 1020965). Figure 14.

Comment. Lance (2011) has called the holotype *Buckley 161* but this seems dubious as Buckley's little label has no number, nor is there a collection number in the protologue. In fact, the '161' is on a separate label supplied by Gideon Linneum that comments on fruiting plants and notes that he has not seen the 'large red haw' in flower. Neither does Linneum's note make any reference to Buckley's specimen. Although only a fragment, the type specimen displays a fine inflorescence at full anthesis surrounded by angular-lobed leaves. The leaf form of the *texana* holotype is quite common in south Texas and matches the prevailing concept of this important species. On the very crowded PH 1020965 sheet there are also two specimens of *Crataegus punctata* Jacquin plus a very large late summer leaf, shown in Fig. 14, possibly belonging to *C. brazoria*.

***Crataegus viburnifolia*** Sargent, *Trees and Shrubs* 2: 145. 1911. **LECTOTYPE** (designated in Phipps 2007a): USA. Texas. Brazoria Co.: Columbia, *B.F. Bush & C.S. Sargent 11*, 23 Mar. 1909 (A). **EPITYPE** (designated here): USA. Texas. Brazoria Co.: Columbia, Sep 1909, *B.F. Bush 912 = tree 11*, 25. (A). Figure 15.

Comment. The diagnostic canary yellow color of the fruit is associated with the epitype.

#### NEW COMBINATIONS

***Crataegus mollis*** (Torrey & Gray) Scheele var. ***meridionalis*** (Sargent) J.B. Phipps, comb. et var. nov. *Crataegus meridionalis* Sargent, J. Arnold Arbor. 1: 252. 1920. **LECTOTYPE** (designated above): USA. Alabama. Hale Co.: Gallion, 17 Apr 1915, T.G. Harbison 11833 (TENN 3345a; isolecotype: A). Figure 8, 9.

It should be noted that *Crataegus meridionalis* was not lectotypified by Lance (2011), so his combination is invalid. *Crataegus meridionalis* is a thorny local race of *C. mollis* of blackland soils which has slightly zigzag twigs, elliptic to narrow-ovate, shallowly but acutely lobed, strongly toothed leaves that are very tomentose abaxially at anthesis.

***Crataegus texana*** Buckley var. ***dasyphylla*** (Sargent) J.B. Phipps, comb. et var. nov. *Crataegus dasyphylla* Sargent, Rep. (Annual) Missouri Bot. Gard. 22: 80. 1912. **LECTOTYPE** (designated in Phipps et al. 2007): USA. Missouri. Jasper Co.: Joplin, 23 Apr. 1909, E.J. Palmer 34 (A). Figure 4.

*Crataegus dasyphylla* is an ovate-leaved, rose-anthered form. The leaves are shallowly and subacutely or sometimes obtusely lobed and white-tomentose abaxially at anthesis with long marginal teeth. This considerably extends the concept of the *C. texana* complex to include the other southwestern pink-anthered forms except for those of the *brazoria* complex.

#### TAXONOMIC REVIEW

*Crataegus* ser. *Molles* is a coherent set of species with a wide range throughout the hawthorn-rich regions of North America to the east of the central Great Plains except for the southeastern piedmont and coastal plain. Series *Molles* are large hawthorns with large leaves, dense indumentum at least in the early stages (often densely white-villous even on the bracteoles), are early-flowering relative to their congeners, have large flowers, and at least the larger bracteoles are large, +/- herbaceous, green, and somewhat persistent. Fruit is commonly large, suborbicular, red, persistently hairy, and commonly with erecto-patent, accrescent sepals.

In the present view there are five species in the series. The primary focus of this review are the *Crataegus mollis* group (two species) and the *C. texana* group (three species), sometimes broadly treated as one species, e.g., Lance (2011), sometimes as several species as here and by Palmer (1950, 1952). They have in common eglandular petioles, 20 stamens, ivory or pink to red anthers, and are trans-Appalachian. They collectively have an extensive synonymy. The other two species are *C. submollis* and *C. pennsylvanica*. This pair have glandular petioles, 5-10 stamens, ivory or palest pink anthers and are nearly perfectly allopatric with the first group, occurring to the north and northeast of them (Wisconsin to Nova Scotia south to North Carolina). A local taxon with 10 stamens, *C. transmississippiensis*, will be evaluated later with the 10-stamen taxa.

I tend to place considerable weight on anther color (basically anthocyanic vs. non-anthocyanic) especially if it can be correlated with other characteristics, even distribution. This derives from discussions with the bee pollination expert, T. Lavery, now deceased, who pointed out the significance of color faithfulness in pollen gathering. This provides a plausible narrative, unfortunately still unchecked as so much else in the adaptive ecology of hawthorns. Anthocyanic anthers in series *Molles* are restricted to a region to the southwest of southern Missouri but non-anthocyanic anthers occur throughout. Other helpful characters in the series are leaf shape and size, thorniness, and in a special case, fruit color. Brilliant yellow fruit is restricted to a few counties of

southeastern Texas while a high level of thorniness, unusual in the eglandular-petiole *Molles*, and is predominantly Ozarkian and in the Gulf states.

#### KEY TO TAXA

Occasional interserial hybrids with similarities to the following taxa may normally be distinguished by their lack of larger herbaceous bracteoles.

1. Pomes yellow, gold or orange; se Texas.
  2. Most leaves +/- elliptic, not lobed, at maturity abaxially glabrous; anthers rose; pomes 8–10 mm diam. .... 2. *Crataegus brazoria* (in part)
  2. Most leaves +/- broad ovate, evidently lobed, at maturity abaxially rough-hairy; anthers ivory; pomes 15–20 mm diam. .... 4. *Crataegus mollis* (in part)
1. Pomes reddish; range of series.
  3. Stamens 5–10; northern or Ozarkian taxa.
    4. Petioles eglandular; styles and nutlets 3–5; Ozarks, ? elsewhere  
..... *Crataegus transmississippiensis*
    4. Petioles +/- eglandular, at least when young; styles and nutlets 4–5; Great Lakes to Nova Scotia and Maine, south to Pennsylvania and Delaware, ? elsewhere.
      5. Anthers white to cream, stamens ca. 10; 2-year-old thorns numerous, shiny black; leaves broadest about one third of the way from the base; usually a bush 5. *Crataegus submollis* (in part)
      5. Anthers white to palest pink, stamens 5–10; 2-year-old thorns usually sparse to none, shiny brown; leaves usually broadest near base; commonly tree-like at maturity  
..... 6. *Crataegus pennsylvanica*
  3. Stamens 20; trans-Appalachian taxa (Minnesota to sw Ontario south to Texas to Alabama).
  6. Anthers non-anthocyanic (white to cream).
    7. Petioles eglandular ..... 4. *Crataegus mollis* (in part)
    7. Petioles glandular ..... 5. *Crataegus submollis* (in part)
  6. Anthers anthocyanic (pink to purple).
    8. Mature leaf blades broad-ovate to +/- isodiametric, 4–5 cm, lobeless or with few shallow obtuse lobes per side, rather bluish at maturity; bushes 20–40 dm on drier sites (–80) dm, very thorny; sw Missouri, n Arkansas ..... 3. *Crataegus lanuginosa*
    8. Mature leaf blades +/- ovate, 4–8 cm, deeply to shallowly 2–4 lobed per side, or +/- elliptic, unlobed or with 1–2 apiculi per side, green at maturity; bushes 40–80 dm, thorns none to few; Missouri to Texas.
      9. Mature leaf blades +/- ovate, deeply to shallowly 2–4 lobed per side; Missouri to Texas  
..... 1. *Crataegus texana*
      9. Mature leaf blades +/- elliptic, 4–8 cm, unlobed or with 1–2 apiculi per side; se and se Texas  
..... 2. *Crataegus brazoria* (in part)

**1. *Crataegus texana* Buckley**

*Crataegus texana* is the principal pink- to red-anthered member of the series and ranges from southern Missouri to southeastern Texas. Variation in leaf shape is considerable and may lead to reassessment of this taxonomy.

1. Leaves with 2–4 deep, +/- angular lobes per side ..... 1a. *C. texana* var. *texana*  
 1. Leaves with 1–2(–3) shallow, +/- obtuse to subacute lobes per side ..... 1b. *C. texana* var. *dasyphylla*

**1a. *C. texana* var. *texana* (Fig. 14)**

This variety is common from the eastern Gulf coast of Texas inland along the I-35 corridor to about halfway to Dallas.

**1b. *C. texana* var. *dasyphylla* (Sargent) J.B. Phipps (Fig. 4)**

The distribution of this variety is still poorly known but it extends from at least southern Arkansas to southern Missouri. Very similar is *C. brachyphylla* Sargent, with only 3 styles and nutlets, but from dry hills in southwestern Arkansas

**2. *Crataegus brazoria* Sargent (Fig. 2)**

*Crataegus brazoria* has a similar range to *C. texana* var. *texana* but is maintained as a distinct species primarily on account of its distinct leaf shape and paucity of intermediates. The elliptic, barely lobed, acute-tipped leaves are very distinctive. The type form, which has not been seen in recent years, has bright yellow fruit and comes from the same area as *C. viburnifolia*. By far the most numerous, though unnamed, form has red fruit. The poorly understood, red-fruited *Crataegus dallastiana* may be the same as this. If the typical form is proven to be a hybrid with the *viburnifolia* form of *C. mollis*, which seems possible, the red-fruited form will require naming.

**3. *Crataegus lanuginosa* Sargent (Fig. 7)**

*Crataegus lanuginosa* comes from the Ozarks, a rich area of endemism for *Crataegus*, at least at the infra-specific level. It resembles *C. texana* var. *dasyphylla* in a general way but has smaller leaves, reported as bluish in summer, and is particularly thorny, an uncommon trait in the 20-stamen group. It occurs on dry hills in which a number of other Ozarkian hawthorn endemics are found.

**4. *Crataegus mollis* (Torrey & Gray) Scheele**

*Crataegus mollis* is treated as a wide-ranging and very variable species found from South Dakota and Minnesota, east to southwestern Ontario and northwest Pennsylvania thence south to Texas and Alabama. It is a basically a 20-stamen, eglandular-petioled, ivory-anthered species. A significant variant, var. *viburnifolia*, has yellow fruit, two of the varieties are markedly thorny while the whole complex has a considerable variety of leaf shape. *Crataegus transmississippiensis*, an Ozarkian form with 10 stamens, is much like some forms of *C. mollis* and will be evaluated in another paper.

1. Thorns on twigs of mature plants us. few to plentiful; twigs slightly flexuous; blades elliptic to oblong-ovate, lobes, if present, acute, shallow; Mississippi to Tennessee

..... 4c. *C. mollis* var. *meridionalis*

1. Thorns on twigs of mature plants us. sparse or none; twigs +/- straight or only irregularly or slightly flexuous; leaves +/- ovate to broad-elliptic, lobes, if present, obtuse to acute, shallow to deeper; throughout region of species.

2. Leaves with 4–6 sharp and deep lobes per side (max L:W 20–40 %) 4c. *C. mollis* var. *incisifolia*

2. Leaves lobeless or with 2–4 +/- shallow, subacute to obtuse lobes per side (max L:W 0–20%).

4. Fruit yellow; south Texas ..... 4d. *C. mollis* var. *viburnifolia*.  
 4. Fruit red; throughout.

5. Leaves with 2-4 subacute to obtuse distinct lobes per side, sinuses evident; throughout range of species except northern Minnesota and Manitoba ..... 4a. *C. mollis* var. *mollis*

5. Leaves with lobes lacking or obscure, sinuses lacking or shallow; n Arkansas to sw Missouri ..... 4b. *C. mollis* var. *dumetosa*

**4a. *C. mollis* var. *mollis* Figure 10.**

This variety is found almost throughout the range of the species. It is thornless to slightly thorny and has shallowly, subacutely to obtusely lobed leaves. *Crataegus graviora* (Fig. 6) is a woodland form from limestone hills in Tennessee and perhaps elsewhere. It is characterized by somewhat small, subacutely lobed leaves and small flowers (ca. 15 mm diam.). If better known it might warrant varietal recognition.

**4b. *C. mollis* var. *dumetosa* (Sargent) Kruschke Figure 5.**

This variety has unlobed to only slightly lobed leaves, is quite thorny, and is Ozarkian in range. It merges into var. *mollis*.

**4c. *C. mollis* var. *incisifolia* Kruschke ex J.B. Phipps Figure 11.**

Variety *incisifolia* has deeply and sharply lobed leaves and seems to have a wide distribution but is inadequately documented. The poorly understood *C. arkansana* (Fig. 1), described from cultivated material but lacking the deeply dissected extension shoot leaves of var. *incisifolia*, may well prove to be the same.

**4d. *C. mollis* var. *viburnifolia* (Sargent) R.W. Lance Figure 15.**

*Crataegus brazoria* var. *viburnifolia* (Sargent) J.B. Phipps

This variety is very similar to var. *mollis* but is restricted to southeast coastal Texas. It has canary-yellow fruit. Yellow-fruited forms with deeply lobed leaves and often slightly anthocyanic anthers are probable hybrids with *C. texana* var. *texana*.

**4e. *C. mollis* var. *meridionalis* (Sargent) J.B. Phipps Figures 8, 9.**

Variety *meridionalis* is found in several southeastern states on blackland soils. It is characterized by thorniness, somewhat zigzag twigs, and elliptic to narrow-ovate leaves rather chartaceous at maturity. The characteristic narrow leaves of the flowering lectotype show clearly in Fig. 8, but in the fruiting specimen (fig. 9) the leaves are broader.

**5. *Crataegus submollis* Sargent Figures 12, 13.**

*Crataegus submollis* is characterized by +/- glandular petioles, 10 stamens (except in a local Montreal form), ivory anthers, and a particularly thorny habit. There is some variation in leaf shape. The flowering lectotype (Fig. 12) has broad-based, sometimes subcordate leaves while the fruiting syntype (Fig. 13) has broad-cuneate to subtruncate leaf bases. *Crataegus canadensis*, the 20-stamen form, except for stamen number, is well within the range of variation of *C. submollis*, its leaf shape being very similar to the fruiting syntype (Fig. 13). *Crataegus submollis* has a large northeastern range presently documented as from Wisconsin to Nova Scotia south to northern Ohio and northern Pennsylvania and is particularly common on limestone.

**6. *Crataegus pennsylvanica* Ashe**

*Crataegus pennsylvanica* is broadly similar to *C. submollis*, differing as indicated in the key. It has a smaller and more southerly range than the latter species, being moderately common only in

southern Ontario, New York, and Pennsylvania and sporadic in Ohio, Delaware, and North Carolina. This species will be typified and illustrated in a forthcoming paper J.A. Macklin and myself.

### ***Crataegus transmississipiensis* Sargent**

*Crataegus transmississipiensis*, an Ozarkian form with 10 stamens, is much like some forms of *C. mollis* and will be evaluated in another paper.

### **ACKNOWLEDGEMENTS**

My thanks finally go to Dave Boufford at Harvard (GH, A) as he has not been sufficiently acknowledged in earlier papers of mine. Boufford, in the 1980s, undertook the massive task of sorting out Sargent's syntypes and types from among many thousands of specimens. Lectotypification of Sargent names is made far easier by his endeavors. I must also thank Melinda Peters, Harvard (GH), who provided type images of most of the syntypes discussed for this paper and sent specimens of others. Alina Freire-Fierro, Philadelphia Academy of Natural Sciences (PH) unearthed the fragmentary type of *Crataegus texana* and J.A. Macklin kindly studied the fruiting syntype of *Crataegus arkansana* for residual indumentum. Jennifer Ogle (UARK) kindly imaged their holdings of the *C. mollis* group for comparison with *C. arkansana*.

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Figure 1. *Crataegus arkansana*. Flowering lectotype. Massachusetts Arnold Arboretum, cult., 18 May 1900, C.S. Sargent(?) 482-2 (A barcode 18257)





Figure 2 *Crataegus brazoria* Flowering isoelectotype Texas: Brazoria Co., Columbia, 25 Mar 1900, *Wm Canby, C.S. Sargent, Wm Trelease* 102 (DOV 4899). There is also a sterile specimen on the same sheet



Figure 3 *Crataegus canadensis*. Flowering lectotype Quebec Chateaugay, 29 May 1900, J.G. Jack 79 (A 18297)



Figure 4 *Crataegus dasyphylla*. Flowering lectotype Missouri Jasper Co, 23 Apr 1909, E.J. Palmer 34 (A 3132).



Figure 5. *Crataegus dumetosa* Flowering lectotype. Missouri, Neck City, 31 Mar 1907, *Palmer* 2 (A 16331)



Figure 6. *Crataegus gravida*. Flowering lectotype. Tennessee: Davidson Co., 'early May' no year, T.G. Harbison 2142 (A 214400)



Figure 7. *Crataegus lanuginosa*. Fruiting syntype: Missouri: Jasper Co., nr Webb City, C.S. Sargent 4, 2 Oct. 1901 (A16746). Flowering ?syntype: Missouri: Jasper Co., nr. Carterville, 26 Apr 1903, E.J. Palmer 1239 (MO 747738).



Figure 8. *Crataegus meridionalis*. Possible isolectotype. Alabama: Hale Co., 17 Apr 1915, T.G. Harbison tree 7 (A 16920).



Figure 9 *Crataegus meridionalis*. Fruiting specimen Alabama: Hale Co., 24 Sep 1999, O'Kennon 14463 & Lance (TRT)



Figure 10. *Crataegus coccinea* var. *mollis*. Flowering lectotype. Ohio: Hamilton Co., Cincinnati, May, no year, T.G. Lea s.n. (NY 532807).



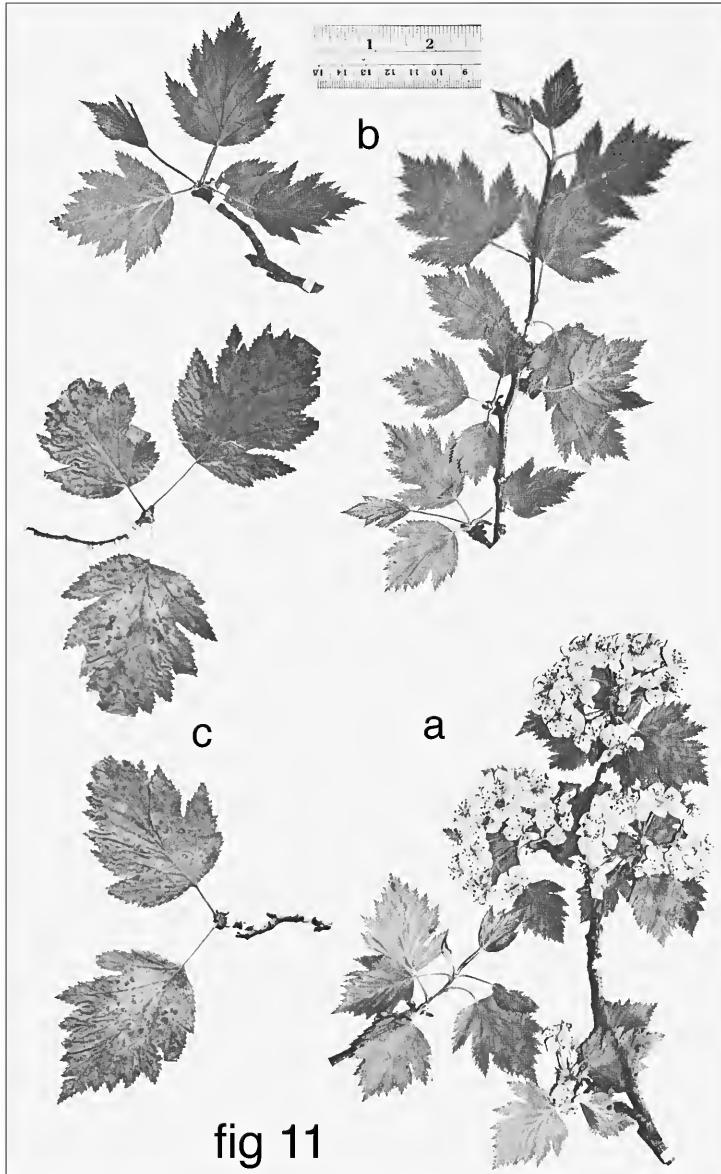


Figure 11. *Crataegus mollis* var. *incisifolia*. Fragments from type tree (Wisconsin: Rock Co., Kruschke K-47-8). Collage from figs 103-105 in Kruschke (1965): (a) flowering specimen; (b) vegetative specimen at about anthesis; (c) mature short-shoot leaves (September).



fig 12

Figure 12. *Crataegus submolles*. Flowering lectotype. Maine: Penobscot Co., Orono, 27 May 1887 M.L. Fernald s.n. (GH 273975).



Figure 13. *Crataegus submollis*. Fruiting syntype Maine York Co, Gerrish I., 17 Sep 1899, J.G. Jack 2 (A 58615).

fig.14

No 161. Large Red, Apple Hawth.

*Crataegus cuneata* <sup>25</sup> - I do not recollect of having seen this haw anywhere out of Texas. There is another large haw here with yellow fruit, which I have found in the Ala. & Miss. (No 36. in this Collection) But is more bushy, does not grow tall. I did not find this beautiful, and quite delicious, eatable, red haw until today (29 Oct) consequently can not give the time of its blooming. 25-30 ft. on the bottom land; no so tall on a plain. Fruit ripe but of Oct. 29.

Note by Dr. L. C. C. C.



Figure 14 *Crataegus texana*. Holotype Texas: Columbia Co., along Brazos and Columbia Rivers, without date, S.B. Buckley s.n., flowering specimen (PH 1020965)



Figure 15. *Crataegus viburnifolia*. Flowering syntype. Texas: Brazoria Co., Columbia, 27 Mar 1902 B.F. Bush 1219, tree 11 (TRT, CM 245998).

## NEW DISTRIBUTION RECORDS OF ACANTHACEAE IN GUATEMALA

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### ABSTRACT

New occurrence records for 11 species of Acanthaceae are reported for Guatemala. Four species, *Justicia breedlovei*, *Justicia ensiflora*, *Louteridium mexicanum*, and *Stenostephanus gracilis* are newly reported for the country, and departmental records are noted for seven additional species. One hundred twenty-eight native species of Acanthaceae have been documented from Guatemala to date.

**KEY WORDS:** Acanthaceae, Guatemala, *Justicia breedlovei*, *Justicia ensiflora*, *Louteridium mexicanum*, *Stenostephanus gracilis*

### RESUMEN

Nuevos registros de ocurrencia de 11 especies de Acanthaceae se reportan en Guatemala. Se registraron cuatro especies, *Justicia breedlovei*, *Justicia ensiflora*, *Louteridium mexicanum* y *Stenostephanus gracilis*, en el país por primera vez, y se destacan nuevos registros departamentales por siete especies adicionales. Ciento veintiocho especies nativas de Acanthaceae son conocidas desde Guatemala hasta la actualidad.

**PALABRAS CLAVES:** Acanthaceae, Guatemala, *Justicia breedlovei*, *Justicia ensiflora*, *Louteridium mexicanum*, *Stenostephanus gracilis*

Taxonomic, ecological, and conservation data of Guatemalan Acanthaceae were recently reviewed and revised (Daniel 2010). Daniel (2010) documented 124 species of the family from Guatemala. Ongoing collecting, primarily by local botanists, as well as continuing studies of historical collections have resulted in 11 new occurrence records of species of Acanthaceae either for the country or for departments within Guatemala. For example, recent collections made in the under-collected departments of Jutiapa and Santa Rosa document the occurrences of six species new to those departments and one species new to the country.

In this update of Guatemala's acanthaceous flora, four species are newly reported for the country: *Justicia breedlovei*, *Justicia ensiflora*, *Louteridium mexicanum*, and *Stenostephanus gracilis*. Thus, 128 native species of Acanthaceae are currently known from Guatemala. This is the highest

number of native species for the family among the seven nations of Central America. Collections of seven additional species represent new departmental records within Guatemala: *Aphelandra speciosa* (Santa Rosa), *Dicliptera unguiculata* (Santa Rosa), *Hypoestes phyllostachya* (Jutiapa), *Lepidagathis guatemalensis* (Jutiapa), *Odontonema tubaeforme* (Baja Verapaz and Jutiapa), *Ruellia blechum* (Jutiapa), *Spathacanthus hahnianus* (Quiché). Collections noted for *Spathacanthus hahnianus*, previously known only from a single collection in Guatemala, are the first in more than 125 years and confirm the persistence of that species in the country.

Descriptions of most Guatemalan Acanthaceae that incorporate taxonomic changes and collections since Gibson's (1974) account of the family in the *Flora of Guatemala* can be found in either Daniel (1995) or Daniel (2010). The following distribution records provide collection information, geographic ranges, and pertinent taxonomic notes (where appropriate).

#### ***Aphelandra speciosa* Brandegee**

**Santa Rosa:** Pueblo Nuevo Viñas, Finca Santa Isabel, 14°12'17.7"N, 90°27'33.7"W, 1044 m, cultivo de café, 22 II 2010 (flr), *L. Velásquez & E. Morales 672* (BIGU, CAS).

This species is endemic to the mountains of southeastern Chiapas and southwestern Guatemala, where it was previously known from Quezaltenango, San Marcos, and Suchitpéquez (Daniel 2010).

#### ***Dicliptera unguiculata* Nees**

**Santa Rosa:** Pueblo Nuevo Viñas, Finca Santa Isabel, 14°12'44.7"N, 90°26'46.8"W, 1055 m, cultivo de café, 23 II 2010 (flr, frt), *L. Velásquez & E. Morales 732* (BIGU, CAS).

This widespread species occurs from southern Mexico to Peru. It has been documented previously from seven departments in Guatemala: Alta Verapaz, Chimaltenango, Guatemala, Jalapa, Quetzaltenango, Sacatepéquez, and Sololá (Daniel 2010). Because the species often occurs in disturbed habitats, it will likely be found in additional departments as well.

#### ***Hypoestes phyllostachya* Baker**

**Jutiapa, Moyuta, Finca Los Ausoles, 14°03'07.32"N, 90°05'43.63"W, 1019 m, cultivo de café, 6 IV 2010 (flr, frt), *L. Velásquez & J. García 870* (BIGU, CAS).**

This commonly cultivated species is native to Madagascar. Daniel (2010) noted that it has become naturalized in at least six departments of Guatemala: Alta Verapaz, Baja Verapaz, Escuintla, Guatemala, Sacatepéquez, and San Marcos. The species, which sometimes forms an extensive ground cover, continues to increase its range in the American tropics.

#### ***Justicia breedlovei* T.F. Daniel**

**Huehuetenango:** Nentón, orillas del Río Salchilá, 15°59'05"N, 91°33'34.3"W, 1588 m, 7 II 2011 (flr, frt), *L. Velásquez & M. Véliz 1656* (BIGU, CAS), *M. Véliz & L. Velásquez 22572* (BIGU, CAS), *22576* (BIGU, CAS), *22603* (BIGU, CAS).

The collections cited above from northern Huehuetenango, near the Chiapan border, are the first from Guatemala. The species was previously known from a nearby region of Chiapas in southern Mexico (Daniel 1995). These collections extend its known flowering and fruiting season from December to February, elevational range from 1170 to 1588 m, height of the shrubs from 1.2 to 2.5 m, petiole length from 25 to 30 mm, capsules length from 9.5 to 11 mm, stipe length from 3 to 4 mm, seed length from 2.5 to 3 mm, and seed width from 2 to 2.3 mm. Seeds of the Guatemalan plants appear to lack the superficial and inconspicuous trichomes evident on those from Chiapas;

however, sparse eglandular trichomes less than 0.05 mm are evident on portions of their margin. Figure 1 shows the striking inflorescences, with maroon bracts and orange flowers, of this species.



Figure 1. Photographs of inflorescences: A. *Justicia breedlovei* (photo by L. Velásquez). B. *Justicia ensiflora* (photo by R. Kriebel).

***Justicia ensiflora* (Standl.) D.N. Gibson**

**Izabal:** Morales, Sierra Caral, hacia la cima, 15 38749°, -88 69357°, 1000 m, 14 Jun 2011 (flr), R. Kriebel *et al.* 5596 (CAS, NY, USCG)

*Justicia ensiflora* was previously known from Belize and Honduras (Gibson 1974; Daniel 2005, 2010: 373). It is distinctive among Guatemalan Acanthaceae by the long (12–18.5 cm) peduncles of the inflorescence, purplish rachis, bright orange calyx and corollas, corollas 56–65 mm long, and anther thecae 4–5 mm long (Figure 1). Capsules and seeds, which are not present on the single known Guatemalan collection, have not been described previously for the species. Based on collections from Honduras (cited in Daniel 2005), they can be described as follows: capsules 14–16 mm long, pubescent with flexuose eglandular trichomes 0.1–0.3 mm long, stipe 5–7 mm long, head subellipsoid, 9 mm long, seeds lenticular, 3 mm long, 2.2 mm wide, rugose.

***Lepidagathis guatemalensis* (Donn. Sm.) Kameyama**

**Jutiapa:** Moyuta, Finca Los Ausoles, 14°02'46.13"N, 90°05'34.20"W, 1180 m, lade de un arroyo, 14 IV 2010 (flr), L. Velásquez & J. García 919 (BIGU, CAS).

This species, previously known as *Lophostachys guatemalensis* Donn. Sm., has been recorded from El Salvador, southern Mexico (Chiapas and Oaxaca), and the following departments of Guatemala: Escuintla, Guatemala, and Santa Rosa (Daniel 2010).

***Louteridium mexicanum* (Bail.) Standl.**

**Alta Verapaz:** Mpio. Rubeltem, Montaña Sacranix, Wegstrecke zwischen der Finca Xalcata (= Saqmoc) und der Finca Sacté, S des Rio Sachichaj (W der Strasse Cobán–Chuséc), ca. 500 m, Kalkkarst, Reste von halbbimmergrünen Wald, 25 III 2001 (flr, frt), H. Foerther *et al.* 10940 (BM).

This is the first record of this species from Guatemala. It can be distinguished from *Louteridium donnell-smithii*, which also occurs in Alta Verapaz, by the pubescence of young stems, leaves, inflorescence rachis, dichasial peduncles, and pedicels. In *L. mexicanum*, these are glabrous



or pubescent with eglandular trichomes to 0.8 (–1) mm long; in *L. donnell-smithii* they are pubescent with glandular and eglandular trichomes up to 2.8 mm long). *Louteridium mexicanum* was previously known only from southern Mexico (Chiapas, Oaxaca, Tabasco, Veracruz; Daniel 1995). As noted by Daniel (2010), plants from Guatemala previously attributed to *L. mexicanum* are *L. purpusii* Brandegee. Label data of Foerther *et al.* 10940 note that Guatemalan plants grow on karst limestone in semievergreen forest remnants and that they had brownish violet corollas.

**Odontonema tubaeforme** (Bertol.) Kuntze

**Baja Verapaz:** Pauzal, 1200 m, *H. von Tuerckheim II* 1752 (BP). **Jutiapa,** Moyuta, Finca Los Ausoles, 14°03'07.32"N, 90°05'43.63"W, 1019 m, cultivo de café, 6 IV 2010 (flr), *L. Velásquez & J. García* 867 (BIGU, CAS).

*Odontonema tubaeforme* occurs from southern Mexico to Panama. Daniel (2010) noted its occurrence in thirteen departments of Guatemala. Von Tuerckheim's locality "Pauzal" in Baja Verapaz has not been located with certainty. However, ca. 12–13 (air) km to the northeast of Purulhá (15°14'7.62"N, 90°14'6.07"W) there is a "Pansal" (Hoa and Hong 2005) with elevations in the nearby mountains up to 2000 m. Von Tuerckheim also collected other plants "between Purulka and Pauzal" (e.g., *Diplazium prominulum* Maxon).

**Ruellia blechum** L.

**Jutiapa:** Moyuta, Finca Los Ausoles, 14°03'07.32"N, 90°05'43.63"W, 1019 m, cultivo de café, 6 IV 2010 (flr), *L. Velásquez & J. García* 869 (BIGU, CAS).

This widely distributed and weedy species, previously known as *Blechum pyramidatum* (Lam.) Urb., occurs from Mexico to Peru. It has been introduced and become naturalized in the southern United States (Florida) and the Paleotropics (e.g., Papua New Guinea). Daniel (2010) noted its occurrence in 14 of Guatemala's 22 departments, and it will likely be found in most of the remaining ones.

**Spathacanthus hahnianus** Baill.

**Quiché:** Chajul, bosque de Finca la Perla, 15.6083724°N, 91.1041225°W, 1400 m, bosque de *Vochysia*, *Gordonia*, *Magnolia*, e *Hieronyma*, 15 XI 2009 (flr, frt), *E. Triboullier & I. Pedro* 409 (BIGU); Chajul, bosque de Finca la Perla, 15°36'19.22"N, 91°6'12.09"W, 1500 m, bosque mesófilo con *Magnolia mexicana* y *Pseudolmedia*, 28 XI 2009 (flr), *E. Triboullier & I. Pedro* 436 (BIGU); Chajul, bosque de aldea Chel, 15.6157966°N, 91.0439035°W, 1800 m, bosque de *Billa*, *Hedyosmum*, *Ocotea*, *Oreopanax*, y *Elaeagia*, 7 XI 2010 (flr), *E. Triboullier & I. Pedro* 469 (BIGU).

This species was previously known from Mexico, Honduras, and Alta Verapaz, Guatemala (Daniel 2005, 2010). Because the sole collection from Guatemala, *von Tuerckheim 1030*—the type of *Spathacanthus simplicifolius* (Donn. Sm.) Lindau, was collected more than 125 years ago, Daniel (2010) indicated that the species was likely rare or possibly extirpated in Guatemala. The collections noted above from Quiché reveal that the species persists in mesophytic montane forests and extend its known fruiting period to November.

**Stenostephanus gracilis** (Oerst.) T.F. Daniel.

**Santa Rosa:** Pueblo Nuevo Viñas, Finca Santa Isabel, 14°12'44.7"N, 90°26'46.9"W, 1061 m, 24 II 2010 (flr), *L. Velásquez & E. Morales* 804 (BIGU, CAS).

This is the first record of the species for Guatemala and for any species of *Stenostephanus* in the department of Santa Rosa. Although known only from plants bearing flowers, this collection has all of the characteristics of *S. gracilis* in Chiapas and Costa Rica (Daniel 1999). Indeed, the

occurrence in southeastern Guatemala provides a geographic link from the previously known occurrences in southern Mexico to those in southern Central America.

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## ***PREMNA WUII* (VERBENACEAE), A NEW NAME FOR *PREMNA VELUTINA* C.Y. WU**

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### **ABSTRACT**

A new name, *Premna wuii* Boufford & B.M. Barthol. (Verbenaceae), is proposed to replace *P. velutina* C.Y. Wu, a later homonym of *P. velutina* Gürke. *Premna wuii* is known only from western Yunnan Province, China.

**KEY WORDS:** *Premna*, Verbenaceae, Flora of China, new name, Yunnan

The appropriately named and distinctive *Premna velutina* C.Y. Wu (see also Wu and Raven, 1998) was, unfortunately, not recognized as a later homonym of *P. velutina* Gürke in the treatment published in the *Flora of China* (Chen & Gilbert 1994) nor in the earlier published treatment in *Flora Republicae Popularis Sinicae* (Chen 1982) and only recently came to light during routine identifications of specimens of *Premna* collected in western Yunnan. Because it is such a distinct species and easily separated from its apparent closest relative, *P. mekongensis* W. Smith, we therefore propose the following new name as a replacement.

**PREMNA WUII** Boufford & B.M. Barthol., **nom. nov.**, based on *Premna velutina* C.Y. Wu, Fl. Yunnan. 1: 428, pl. 102, f. 8–10. 1977. Not Gürke, Pflanzenw. Ost-Afrikas 100: 338. 1895.

We are pleased to name this species for Professor Wu Zhengyi (Wu Cheng-Yi), who has devoted his life to the study of Chinese plants and whose knowledge of the Chinese flora is beyond comparison.

### **ACKNOWLEDGMENTS**

We thank Professor Li Heng for examining the type specimen of *Premna velutina* C.Y. Wu in the herbarium of the Kunming Institute of Botany (KUN) and comparing it with recent collections made in the Gaoligong Shan region of Yunnan, China.

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## ATLAS OF THE FLORA OF NEW ENGLAND: ROSACEAE

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### ABSTRACT

Dot maps are provided to depict the distribution at the county level of the taxa of Magnoliophyta: Rosaceae growing outside of cultivation in the six New England states of the northeastern United States. The maps treat 270 taxa (species, subspecies, varieties, and hybrids, but not forms) based primarily on specimens in the major herbaria of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, with most data derived from the holdings of the New England Botanical Club Herbarium (NEBC). Brief synonymy (to account for names used in standard manuals and floras for the area and on herbarium specimens), habitat, chromosome information, and common names are also provided.

**KEY WORDS:** flora, New England, atlas, distribution, Rosaceae

This article is the tenth in a series (Angelo & Boufford 1996, 1998, 2000, 2007, 2010, 2011a, 2011b, 2012a, 2012b) that presents the distributions of the vascular flora of New England in the form of dot distribution maps at the county level (Figure 1). The atlas is posted on the internet at <http://neatlas.org>, where it will be updated as new information becomes available.

This project encompasses all vascular plants (lycophytes, pteridophytes and spermatophytes) at the rank of species, subspecies, and variety growing independent of cultivation in the six New England states. Hybrids are also included, but forms and other ranks below the level of variety are not. The dots are based on voucher specimens primarily in New England herbaria (of colleges, universities, botanical gardens, and public museums) representing reproducing populations outside of cultivated habitats. This tenth installment includes the family Rosaceae (Magnoliophyta). Of the 283 taxa treated (270 mapped), 95 are not native to the region. Future accounts will treat the distribution of additional non-monocot angiosperms.

The habitat data are distillations from a variety of sources augmented by our own field observations. An attempt was made to indicate habitat information as it applies to a particular taxon in New England rather than to the entire range of the taxon. Habitat information is not provided for hybrid taxa.

It is our hope that these articles will stimulate additional field work to supplement the distributions portrayed in the maps. The New England Botanical Club herbarium has proven to be the most important resource for this project. We are eager to receive information on voucher specimens in public herbaria documenting range extensions and filling county gaps in distributions. Similarly, because the atlas of the New England flora will be continuously updated as new information becomes available, we are eager to receive notification of published corrections of cytological information and new, documented chromosome counts for taxa in the New England flora.

## MATERIALS AND METHODS

Materials and methods are as outlined in Angelo and Boufford (1996) and in a web version (Angelo & Boufford 2011c) and are not repeated here.

## TAXONOMY AND FORMAT

The taxonomy and nomenclature adopted for this work essentially follow that of draft treatments for the Flora of North America project, except for *Crataegus* and *Rubus* (as explained in the sections for those genera) and except that families, genera, and species are arranged alphabetically. The families and their circumscription do not necessarily reflect current views on relationships or composition. The Angiosperm Phylogeny Website (Stevens 2001 onwards) should be consulted for a continuously updated treatment of families and their inclusive genera. Named and unnamed hybrid taxa are placed alphabetically at the end of the genus in which they occur. Unnamed hybrids combine the names of the progenitors alphabetically by epithet. Taxa that are not native to New England are indicated by uppercase text. Unpublished names are not used, even if publication is pending.

Chromosome numbers are taken primarily from draft treatments for the Flora of North America project and from Goldblatt and Johnson (1979-).

Synonymy is provided primarily with respect to names accepted in standard manuals covering New England published from 1950 onward, including Fernald (1950), Gleason and Cronquist (1991), and Seymour (1982) and on herbarium labels in New England herbaria. Synonyms have not been provided where the distribution for the synonymized name does not include New England.

The following list (which includes excluded taxa) will aid readers in finding familiar names that have been transferred to other taxa:

<i>Cydonia</i> (in part)	=>	<i>Chaenomeles</i>
<i>Dalibarda</i>	=>	<i>Rubus</i>
<i>Potentilla</i> (in part)	=>	<i>Comarum</i>
<i>Potentilla</i> (in part)	=>	<i>Dasiphora</i>
<i>Potentilla</i> (in part)	=>	<i>Drymocallis</i>
<i>Potentilla</i> (in part)	=>	<i>Duchesnea</i>
<i>Potentilla</i> (in part)	=>	<i>Sibbaldiopsis</i>
<i>Pyrus</i> (in part)	=>	<i>Aronia</i>
<i>Pyrus</i> (in part)	=>	<i>Malus</i>
<i>Pyrus</i> (in part)	=>	<i>Sorbus</i>
<i>Sanguisorba</i> (in part)	=>	<i>Poteridnum</i>

The following species have been reported from our area but are excluded for the reasons noted:

*ARUNCUS DIOICUS* (Walter) Fernald var. *VULGARIS* (Maximowicz) H. Hara [no voucher found; reported from Maine]

*MALUS HUPEHENSIS* (Pampanini) Rehder [no voucher found; reported from Massachusetts]

*MALUS MANDSHURICA* (Maximowicz) Komarov ex Juzepczuk [no voucher found; reported from Massachusetts]

*POTENTILLA ALBA* Linnaeus [no voucher of wild occurrence found; reported from Connecticut and Massachusetts]

*POTENTILLA COLLINA* Wibel [no voucher found; reported from Massachusetts]

*POTENTILLA ERECTA* (Linnaeus) Raeschel [no voucher found; reported from Massachusetts]

*PRUNUS SPECIOSA* (Koidzumii) Nakai [no voucher found; reported from Massachusetts]

*ROSA CAROLINA* Linnaeus subsp. *SUBSERRULATA* (Rydberg) W.H. Lewis (*R. CAROLINA* Linnaeus var. *SETIGERA* Crépín) [no voucher found; reported from Maine, New Hampshire and Vermont]

*ROSA MULTIFLORA* Thunberg var. *CALVA* Franchet & Savatier [voucher has been re-identified as *R. MULTIFLORA* var. *MULTIFLORA*; reported from Massachusetts]

*ROSA SEMPERVIRENS* Linnaeus [no voucher found; reported from Massachusetts]

*ROSA TOMENTOSA* Smith [no voucher found; reported from Vermont]

*Rosa* × *palustriformis* Rydberg (*pro species*), (*R. blanda* Aiton × *R. palustris* Marshall) [no voucher found; reported from Maine]

*Rubus arcticus* Linnaeus subsp. *acaulis* (Michaux) Focke (*R. acaulis* Michaux) [no voucher found; reported from Maine]

*RUBUS PARVIFLORUS* Nuttall [no voucher found; reported from Massachusetts]

*SORBUS ALNIFOLIA* (Siebold & Zuccarini) K. Koch [no voucher found; reported from Massachusetts]

*SORBUS HYBRIDA* Linnaeus (*Pyrus hybrida* (Linnaeus) Smith) [no voucher of wild occurrence found; reported from Maine, New Hampshire and Vermont]

*SORBUS* × *THURINGIACA* (Nyman) Schönach (*S. ARIA* (Linnaeus) Crantz × *S. AUCUPARIA* Linnaeus) [no voucher found; reported from New Hampshire and Vermont]

*SPIRAEA CORIMBOSA* Rafinesque [no voucher of wild occurrence found; reported from Massachusetts]

*SPIRAEA SALICIFOLIA* Linnaeus [no voucher found; reported from Vermont]

## ANGIOSPERMAE (MAGNOLIOPHYTA) - ANGIOSPERMS

## ROSACEAE

*AGRIMONIA EUPATORIA* Linnaeus—Church Steeples (Figure 2).  $2n = 28, 56$ . Waste places, fields. From Eurasia, northern Africa.

*Agrimonia gryposepala* Wallroth—(Figure 2).  $2n = 56$ . Thickets, deciduous or mixed woods, roadsides.

*Agrimonia microcarpa* Wallroth—(Figure 2).  $2n = ?$  Rocky woods.

*Agrimonia parviflora* Aiton—(Figure 2).  $2n = 28$ . Calcareous river thickets, riverbanks, meadows, moist woods in circumneutral soil, moist, sandy roadsides.

*Agrimonia pubescens* Wallroth—(Figure 2).  $2n = 28$ . Rich, open, deciduous or mixed woods, swamps. [*A. bicknellii* (Kearney) Rydberg; *A. mollis* (Torrey & A. Gray) Britton; *A. mollis* var. *bicknellii* Kearney]

*Agrimonia rostellata* Wallroth—Woodland Agrimony (Figure 2).  $2n = 28$ . Dry, open, rocky woods.

*Agrimonia striata* Michaux—(Figure 2).  $2n = 56$ . Thickets, woodland borders, woods.

*ALCHEMILLA FILICAULIS* Buser subsp. *VESTITA* (Buser) M.E. Bradshaw—(Figure 2).  $2n = ca. 101-109$ . Wool waste. From Europe. [*A. VULGARIS* Linnaeus var. *VESTITA* (Buser) Fernald & Wiegand]

*ALCHEMILLA MONTICOLA* Opiz—(Figure 2).  $2n = 101-104, 106-110$ . Woods, fields, roadsides. From Eurasia. [*A. PRATENSIS* – misapplied; *A. VULGARIS* – misapplied]

*Amelanchier arborea* (F. Michaux) Fernald—Downy Shadbush (Figure 3).  $2n = 34, 68$ . Rocky, upland or dry, rich woods, thickets.

*Amelanchier bartramiana* (Tausch) M. Roemer—Mountain Shadbush (Figure 3).  $2n = 34, 68$ . Cold swamps, bogs, moist thickets, cool woods, bushy slopes, mountain summits.

*Amelanchier canadensis* (Linnaeus) Medikus var. *canadensis*—Eastern Shadbush (Figure 3).  $2n = 34, 51, 68$ . Woods, moist thickets, swamps, marsh borders. [*A. oblongifolia* (Torrey & A. Gray) M. Roemer var. *oblongifolia*]

*Amelanchier gaspensis* (Wiegand) Fernald & Weatherby—(Figure 3).  $2n = ?$  River shores and their outcrops.

*Amelanchier humilis* Wiegand—(Figure 3).  $2n = 34, 68$ . Calcareous ledges.

*Amelanchier interior* E.L. Nielsen—(Figure 3).  $2n = 68$ . Rocky slopes, stream banks, sandy areas. [*A. wiegandii* E.L. Nielson]

*Amelanchier intermedia* Spach—(Figure 3).  $2n = 68$ . Swamps, bogs, thickets, shores.

*Amelanchier laevis* Wiegand—Smooth Shadbush (Figure 3).  $2n = 34, 68$ . Woodland borders, damp thickets, fields, roadsides.

*Amelanchier nantucketensis* E.P. Bicknell—(Figure 3).  $2n = 28$ . Dry fields, sandy grasslands, heaths, pine barrens, pond and river shores among rocks or in sand. [*A. canadensis* (Linnaeus) Medikus var. *micropetala* (B.L. Robinson) Rehder; *A. oblongifolia* (Torrey & A. Gray) M. Roemer var. *micropetala* B.L. Robinson]

*Amelanchier sanguinea* (Pursh) de Candolle—Red-twigged Shadbush (Figure 4).  $2n = 34, 51, 68$ . Riverbanks, ledges, woodland borders.

*Amelanchier spicata* (Lamarck) K. Koch—Thicket Shadbush (Figure 4).  $2n = 51, 68$ . Rocky or sandy, open habitats, typically in acidic soil. [*A. stolonifera* Wiegand]

— *Amelanchier* hybrids —

*Amelanchier arborea* (F. Michaux) Fernald  $\times$  *A. bartramiana* (Tausch) M. Roemer—(Figure 4).

*Amelanchier arborea* (F. Michaux) Fernald  $\times$  *A. canadensis* (Linnaeus) Medikus var. *canadensis*—(Figure 4).

*Amelanchier arborea* (F. Michaux) Fernald  $\times$  *A. laevis* Wiegand—(Figure 4).

*Amelanchier arborea* (F. Michaux) Fernald  $\times$  *A. spicata* (Lamarck) K. Koch—(Figure 4).

*Amelanchier bartramiana* (Tausch) M. Roemer  $\times$  *A. canadensis* (Linnaeus) Medikus var. *canadensis*—(Figure 4).

*Amelanchier bartramiana* (Tausch) M. Roemer  $\times$  *A. spicata* (Lamarck) K. Koch—(Figure 4).

*Amelanchier canadensis* (Linnaeus) Medikus var. *canadensis*  $\times$  *A. laevis* Wiegand—(Figure 4).

*Amelanchier canadensis* (Linnaeus) Medikus var. *canadensis*  $\times$  *A. spicata* (Lamarck) K. Koch—(Figure 5).

*Amelanchier humilis* Wiegand  $\times$  *A. laevis* Wiegand—(Figure 5).

*Amelanchier laevis* Wiegand  $\times$  *A. sanguinea* (Pursh) de Candolle—(Figure 5).

*Amelanchier laevis* Wiegand  $\times$  *A. spicata* (Lamarck) K. Koch—(Figure 5).

*Amelanchier*  $\times$  *neglecta* Eggleston ex G.N. Jones (*pro species*)—(Figure 5). [*A. bartramiana* (Tausch) M. Roemer  $\times$  *A. laevis* Wiegand]

*Amelanchier sanguinea* (Pursh) de Candolle  $\times$  *A. spicata* (Lamarck) K. Koch—(Figure 5).

*Aronia arbutifolia* (Linnaeus) Persoon—Red Chokeberry (Figure 5).  $2n = 34, 68$  (New England). Low woods, thickets, swamps, shores. [*Photinia pyrifolia* (Lamarck) K.R. Robinson & J.B. Phipps; *Pyrus arbutifolia* (Linnaeus) Linnaeus f.]



*Aronia melanocarpa* (Michaux) Elliott—Black Chokeberry (Figure 5).  $2n = 34$  (New England), 68 (outside New England). Low woods, thickets, swamps, shores, sand dunes, dry, rocky slopes, bluffs, clearings, roadsides. [*A. arbutifolia* (Linnaeus) Persoon var. *nigra* (Willdenow) F. Seymour; *Photinia melanocarpa* (Michaux) K.R. Robinson & J.B. Phipps; *Pyrus melanocarpa* (Michaux) Willdenow]

— *Aronia* hybrid —

*Aronia* × *prunifolia* (Marshall) Rehder (*pro species*)—Purple Chokeberry (Figure 5). Swamps, shores, low thickets, clearings. [*A. arbutifolia* (Linnaeus) Persoon × *A. melanocarpa* (Michaux) Elliott; *A. arbutifolia* (Linnaeus) Persoon var. *atropurpurea* (Britton) F. Seymour; *A. atropurpurea* Britton; *A. floribunda* (Lindley) Sweet; *Photinia floribunda* (Lindley) K.R. Robinson & J.B. Phipps; *Pyrus floribunda* Lindley]

*ARUNCUS DIOICUS* (Walter) Fernald var. *DIOICUS*—Buck's-beard (Figure 6).  $2n = 18$ . Waste places, roadsides, openings and borders of mixed woods. From farther west and south.

*CHAENOMELES JAPONICA* (Thunberg) Lindley ex Spach—Japanese Flowering-quince (Figure 6).  $2n = 34$  (India). Railroad ditches, moist woods. From Japan. [*CYDONIA JAPONICA* (Thunberg) Persoon]

*CHAENOMELES SPECIOSA* (Sweet) Nakai—Chinese Flowering-quince (Figure 6).  $2n = 34$ . Woods by pond shore, roadsides, thickets. From China, southeastern Asia. [*CYDONIA SPECIOSA* Sweet]

*Comarum palustre* Linnaeus—Marsh Cinquefoil (Figure 6).  $2n = 28, 42$ . Pond and lake shores, meadows, marshes, bogs, swamps. [*Potentilla palustris* (Linnaeus) Scopoli var. *palustris*; *P. palustris* var. *villosa* (Persoon) Lehmann]

*COTONEASTER DIVARICATUS* Rehder & E.H. Wilson—(Figure 6).  $2n = ?$  Shady thickets, epiphyte in fork of maple tree. From China.

*Crataegus* taxonomy

Due to the significant diversity of taxonomic treatments for this genus over the years and the complicated reproductive mechanisms known to occur (hybridization, polyploidy, aneuploidy, apomixis), the listing here largely follows that of Gleason and Cronquist (1991) which groups many species considered separate by others. The works of Phipps and Muniyamma (1980) and of Kruschke (1965) have been used to place some names in synonymy. Certain obscure taxa collected only a few times in limited locations are listed here without mapping. The reforestation of New England since the early 20<sup>th</sup> century has greatly reduced the open habitat and fencerows preferred by members of this genus, making it likely that obscure taxa and many hybrids will never be seen again.

*Crataegus baccata* Sargent—obscure taxon known only from historic collections in Worcester County, Massachusetts.

*Crataegus brainerdii* Sargent—(Figure 6).  $2n = ?$  Thickets, fields, woodland margins, roadsides. [*C. brainerdii* var. *asperifolia* (Sargent) Eggleston; *C. brainerdii* var. *cyclophylla* (Sargent) E.J. Palmer; *C. brainerdii* var. *egglestonii* (Sargent) B.L. Robinson; *C. brainerdii* var. *scabrida* Eggleston; *C. asperifolia* Sargent; *C. cyclophylla* Sargent; *C. egglestonii* Sargent; *C. scabrida*

Sargent var. *scabrida*; *C. scabrida* var. *asperifolia* (Sargent) Kruschke; *C. scabrida* var. *cyclophylla* (Sargent) Kruschke; *C. scabrida* var. *egglestonii* (Sargent) Kruschke]

*Crataegus bristolensis* Sargent—obscure taxon known only from historic collections in Bristol County, Massachusetts.

*Crataegus calpodendron* (Ehrhart) Medikus—Pear Hawthorn (Figure 6).  $2n = 34$ . Thickets, open woods, woodland margins.

*Crataegus chrysocarpa* Ashe—Round-leaved Hawthorn (Figure 6).  $2n = 34, 68$ . Thickets, fields, woodland margins, roadsides. [*C. chrysocarpa* var. *blanchardii* (Sargent) J.B. Phipps; *C. chrysocarpa* var. *faxonii* (Sargent) Eggleston; *C. chrysocarpa* var. *phoenicea* E.J. Palmer ex J.B. Phipps; *C. chrysocarpa* var. *praecox* (Sargent) J.B. Phipps; *C. brunetiana* Sargent var. *brunetiana*; *C. brunetiana* var. *fernaldii* (Sargent) E.J. Palmer; *C. dodgei* Ashe; *C. faxonii* Sargent var. *faxonii*; *C. faxonii* var. *praetermissa* (Sargent) E.J. Palmer; *C. fernaldii* Sargent; *C. flavida* Sargent; *C. irrita* Sargent var. *irrita*; *C. irrita* var. *blanchardii* (Sargent) Eggleston; *C. jonesae* Sargent; *C. keepii* Sargent; *C. laurentiana* Sargent var. *brunetiana* (Sargent) Kruschke; *C. lumaria* Ashe; *C. oakesiana* Eggleston; *C. praecoqua* Sargent – illegitimate name; *C. rotundata* Sargent; *C. rotundifolia* – misapplied]

*Crataegus coccinea* Linnaeus—Scarlet Hawthorn (Figure 6).  $2n = 34, 68$ . Thickets, fields, woodland margins, roadsides. [*C. coccinea* var. *pringlei* (Sargent) J.A. Macklin & J.B. Phipps; *C. corrusca* – misapplied; *C. eamesii* Sargent; *C. holmesiana* Ashe var. *holmesiana*; *C. holmesiana* var. *magniflora* (Sargent) E.J. Palmer; *C. holmesiana* var. *villipes* Ashe; *C. magniflora* Sargent; *C. pedicellata* Sargent var. *pedicellata*; *C. pedicellata* var. *robesoniana* (Sargent) E. J. Palmer; *C. polita* Sargent; *C. pringlei* Sargent var. *pringlei*; *C. pringlei* var. *exclusa* (Sargent) Eggleston; *C. pringlei* var. *lobulata* (Sargent) Eggleston; *C. sejuncta* Sargent]

*Crataegus coccinioides* Ashe—Kansas Hawthorn (Figure 7).  $2n = ?$  Thickets, fields, woodland margins, roadsides. [*C. dilatata* Sargent]

*Crataegus crus-galli* Linnaeus—Cockspur Hawthorn (Figure 7).  $2n = 24, 51, 64, 68$ . Thickets, fields, woodland margins, early successional woodlands, roadsides. [*C. crus-galli* var. *exigua* (Sargent) Eggleston; *C. crus-galli* var. *pyracanthifolia* Aiton; *C. persimilis* Sargent; *C. schizophylla* Eggleston]

*Crataegus emersoniana* Sargent—obscure taxon known only from historic collections in Bristol County, Massachusetts.

*Crataegus forbesae* Sargent—obscure taxon known only from historic collections in Worcester County, Massachusetts and New London County, Connecticut.

*Crataegus fulgens* Sargent—obscure taxon known only from historic collections in Fairfield County, Connecticut.

*Crataegus hystricina* Ashe—obscure taxon known only from historic collections in Fairfield County, Connecticut and New York state.

*Crataegus intricata* Lange—Biltmore Hawthorn (Figure 7).  $2n = ?$  Woodland openings and margins, thickets, fields, roadsides. [*C. intricata* var. *boyntonii* (Beadle) Kruschke; *C. intricata* var. *straminea* (Beadle) E.J. Palmer; *C. biltmoreana* Beadle var. *biltmoreana*; *C. biltmoreana* var. *stonei* (Sargent) Kruschke; *C. bissetii* Sargent; *C. boyntonii* Beadle; *C. foetida* Ashe; *C. modesta* Sargent; *C. stonei* Sargent]

*Crataegus macrosperma* Ashe—Variable Hawthorn (Figure 7).  $2n = 68$ . Open woods, early successional woods, thickets, fields, woodland margins, roadsides. [*C. macrosperma* var. *acutiloba* (Sargent) Eggleston; *C. macrosperma* var. *demissa* (Sargent) Eggleston; *C. macrosperma* var. *matura* (Sargent) Eggleston; *C. macrosperma* var. *pastorum* (Sargent) Eggleston; *C. macrosperma* var. *pentandra* (Sargent) Eggleston; *C. macrosperma* var. *roanensis* (Ashe) E. J. Palmer; *C. basilica* Beadle; *C. beckwithae* Sargent; *C. brumalis* Ashe; *C. comata* Sargent; *C. compta* Sargent; *C. diffusa* Sargent; *C. edsonii* Sargent; *C. flabellata* (Bosc ex Spach) K. Koch var. *flabellata*; *C. flabellata* var. *grayana* (Eggleston) E.J. Palmer; *C. fluviatilis* Sargent; *C. glaucophylla* Sargent; *C. grayana* Eggleston; *C. iracunda* Beadle var. *iracunda*; *C. iracunda* var. *brumalis* (Ashe) Kruschke; *C. iracunda* var. *diffusa* (Sargent) Kruschke; *C. lemingtonensis* Sargent; *C. levis* Sargent; *C. matura* Sargent; *C. pastorum* Sargent; *C. populnea* Ashe; *C. randiana* Sargent; *C. roanensis* Ashe; *C. robbinsiana* Sargent; *C. schuettei* Ashe var. *schuettei*; *C. schuettei* Ashe var. *basilica* (Beadle) J.B. Phipps]

*Crataegus mollis* (Torrey & A. Gray) Scheele—Downy Hawthorn (Figure 7).  $2n = 34, 68$ . Thickets, fields, woodland margins, roadsides. [*C. arnoldiana* Sargent; *C. champlainensis* Sargent; *C. pedicellata* Sargent var. *albicans* (Ashe) E.J. Palmer; *C. submollis* Sargent]

*CRATAEGUS MONOGYNA* Jacquin—English Hawthorn (Figure 7).  $2n = 34, 51$ . Roadsides, woodland margins, open, moist woods, fields. From Eurasia, northern Africa.

*Crataegus napaea* Sargent—obscure taxon known only from historic collections in Litchfield County, Connecticut.

*Crataegus neolondinensis* Sargent—obscure taxon known only from historic collections in New London County, Connecticut.

*Crataegus paddockae* Sargent—obscure taxon known only from historic collections in Caledonia and Essex Counties, Vermont.

*CRATAEGUS PHAENOPYRUM* (Linnaeus f.) Medikus—Washington Hawthorn (Figure 7).  $2n = ?$  Thickets, roadsides. From farther south. [*C. cordata* (Miller) Aiton]

*Crataegus pruinosa* (H.L. Wendland) K. Koch—Frosted Hawthorn (Figure 7).  $2n = 51, 68, 72$ . Thickets, fields, woodland margins, roadsides. [*C. pruinosa* var. *dissona* (Sargent) Eggleston; *C. pruinosa* var. *latisejala* (Ashe) Eggleston; *C. pruinosa* var. *porteri* (Britton) Eggleston; *C. bellula* Sargent; *C. cognata* Sargent; *C. conjuncta* Sargent; *C. deltoides* Ashe; *C. dissona* Sargent var. *dissona*; *C. dissona* var. *bellula* (Sargent) Kruschke; *C. fusca* Sargent; *C. incisa* Sargent; *C. jesupii* Sargent; *C. littoralis* Sargent; *C. peguorum* Sargent; *C. porteri* Britton var. *caerulescens* (Sargent) E.J. Palmer; *C. rugosa* Ashe]

*Crataegus punctata* Jacquin—(Figure 7).  $2n = 34, 68$ . Thickets, fields, woodland margins, roadsides. [*C. punctata* var. *aurea* Aiton; *C. suborbiculata* Sargent; *C. tomentosa* Linnaeus var. *punctata* (Jacquin) A. Gray]

*Crataegus quinebaugensis* Sargent—obscure taxon known only from historic collections in New London County, Connecticut.

*Crataegus straffordensis* Sargent—obscure taxon known only from historic collections in Fairfield County, Connecticut.

*Crataegus succulenta* Schrader ex Link—Long-spined Hawthorn (Figure 8).  $2n = 34, 51$ . Thickets, fields, woodland margins, roadsides. [*C. succulenta* var. *macracantha* (Loddiges ex Loudon) Eggleston; *C. succulenta* var. *neofluviialis* (Ashe) E.J. Palmer; *C. succulenta* var. *pisifera* (Sargent) Kruschke; *C. ferentaria* Sargent; *C. fertilis* Sargent; *C. florifera* Sargent var. *shirleyensis* (Sargent) Kruschke; *C. macracantha* Loddiges ex Loudon var. *macracantha*; *C. macracantha* var. *occidentalis* (Britton) Eggleston; *C. pisifera* Sargent; *C. shirleyensis* Sargent]

*Crataegus thayeri* Sargent—obscure taxon known only from historic collections in Middlesex and Worcester Counties, Massachusetts.

*Crataegus umbratilis* Sargent—obscure taxon known only from historic collections at one site in Litchfield County, Connecticut, and one town in Pennsylvania.

— *Crataegus* hybrids —

*Crataegus* × *anomala* Sargent (*pro species*)—(Figure 8). [*C. mollis* (Torrey & A. Gray) Scheele × *C. pedicellata* Sargent]

*Crataegus* × *haemacarpa* Ashe (*pro species*)—(Figure 8). [*C. macrosperma* Ashe × *C. pruinosa* (H.L. Wendland) K. Koch; *C. media* Sargent]

*Crataegus* × *hudsonica* Sargent (*pro species*)—(Figure 8). [*C. pruinosa* (H.L. Wendland) K. Koch × *C. punctata* Jacquin; ?*C. bicknellii* (Eggleston) Eggleston; ?*C. chrysocarpa* Ashe var. *bicknellii* (Eggleston) E.J. Palmer]

*Crataegus* × *ideae* Sargent (*pro species*)—(Figure 8). [*C. brainerdii* Sargent × *C. chrysocarpa* Ashe]

*Crataegus* × *kennedyi* Sargent (*pro species*)—(Figure 8). [*C. brainerdii* Sargent × *C. pruinosa* (H.L. Wendland) K. Koch]

*Crataegus* × *lucorum* Sargent (*pro species*)—(Figure 8). [*C. macrosperma* Ashe × *C. pedicellata* Sargent; *C. fetalis* Sargent; *C. insolens* Sargent; *C. knieskerniana* Sargent]

*Crataegus* × *pilosa* Sargent (*pro species*)—(Figure 8). [*C. intricata* Lange × *C. pruinosa* (H.L. Wendland) K. Koch]

*Crataegus* × *spatiosa* Sargent (*pro species*)—(Figure 8). [*C. pruinosa* (H.L. Wendland) K. Koch × *C. succulenta* Schrader ex Link; *C. chadsfordiana* Sargent; *C. handyae* Sargent; *C. membranacea* Sargent]

*Crataegus* × *websteri* Sargent (*pro species*)—(Figure 9). [*C. brainerdii* Sargent × *C. calpodendron* (Ehrhart) Medikus]

*CYDONIA OBLONGA* Miller—Quince (Figure 9).  $2n = 34$ . Roadsides, railroads. From central and western Asia.

*Dasiphora fruticosa* (Linnaeus) Rydberg—Shrubby Cinquefoil (Figure 9).  $2n = 14, 28$ . Meadows, swamps, fields, ledges, usually in calcareous soil. [*D. fruticosa* subsp. *floribunda* (Pursh) Kartesz; *Pentaphylloides floribunda* (Pursh) Å. Löve; *Potentilla fruticosa* Linnaeus]

*Drymocallis arguta* (Pursh) Rydberg—Tall Cinquefoil (Figure 9).  $2n = 14$ . Dry fields, open rocky woods, ledges, usually in calcareous soil. [*Potentilla arguta* Pursh]

*DUCHESNEA INDICA* (Andrews) Focke var. *INDICA*—Mock Strawberry (Figure 9).  $2n = 84$ . Waste places, railroads. From Asia. [*POTENTILLA INDICA* (Andrews) Th. Wolf]

*EXOCHORDA RACEMOSA* (Lindley) Rehder—Common Pearlbush (Figure 9).  $2n = 16, 18$ . Roadsides, thickets. From Asia.

*FILIPENDULA RUBRA* (Hill) B.L. Robinson—Queen-of-the-prairie (Figure 9).  $2n = ?$  Roadsides, meadows. Probably from farther south and west.

*FILIPENDULA ULMARIA* (Linnaeus) Maximowicz—Queen-of-the-meadow (Figure 9).  $2n = 14, 16, 24$ . Roadsides, riverbanks. From Eurasia. [*F. ULMARIA* var. *DENUDATA* (J. Presl & C. Presl) Maximowicz]

*FILIPENDULA VULGARIS* Moench—Dropwort (Figure 9).  $2n = 14, 15-16$ . Roadsides, waste places. From Eurasia, northern Africa. [*F. HEXAPETALA* Gilbert ex Maximowicz – illegitimate name]

*FRAGARIA VESCA* Linnaeus subsp. *VESCA*—European Strawberry (Figure 10).  $2n = 14$ . Rocky woods, woodland margins, openings. From Eurasia.

*Fragaria vesca* Linnaeus subsp. *americana* (Porter) Staudt—Woodland Strawberry (Figure 10).  $2n = 14$ . Wooded slopes, rocky banks, openings, roadsides.

*Fragaria virginiana* Miller subsp. *virginiana*—Wild Strawberry (Figure 10).  $2n = 56$ . Fields, woodland borders, open slopes, roadsides, railroads.

*Fragaria virginiana* Miller subsp. *glauca* (S. Watson) Staudt—(Figure 10).  $2n = 56$ . Fields, woodland borders, open slopes, roadsides, railroads. [*F. virginiana* var. *terra-novae* (Rydberg) Fernald & Wiegand]

*FRAGARIA VIRGINIANA* Miller subsp. *GRAYANA* (E. Vilmorin ex J. Gay) Staudt—(Figure 10).  $2n = 56$ . Roadsides. From farther west. [*F. VIRGINIANA* var. *ILLINOENSIS* A. Gray]

— *Fragaria* hybrid —

*FRAGARIA* × *ANANASSA* (Weston) Duchesne ex Grozier (*pro species*)—Garden Strawberry (Figure 10). [*F. CHILOENSIS* (Linnaeus) Miller × *F. virginiana* Miller]

*Geum aleppicum* Jacquin—Yellow Avens (Figure 10).  $2n = 42$ . Thickets, woods, meadows, clearings. [*G. aleppicum* var. *strictum* (Aiton) Fernald]

*Geum canadense* Jacquin—White Avenes (Figure 10).  $2n = 42$ . Rich thickets, open woods, woodland margins, fields, roadsides. [*G. canadense* var. *camporum* (Rydberg) Fernald & Weatherby]

*Geum laciniatum* Murray—Rough Avenes (Figure 10).  $2n = 42$ . Moist thickets, meadows, roadsides. [*G. laciniatum* var. *trichocarpum* Fernald]

*Geum macrophyllum* Willdenow var. *macrophyllum*—(Figure 11).  $2n = 42$ . Wet woods, thickets, fields, roadsides.

*Geum peckii* Pursh—Mountain Avenes (Figure 11).  $2n = 42$ . Wet ledges, alpine meadows.

*Geum rivale* Linnaeus—Purple Avenes (Figure 11).  $2n = 42$ . Swamps, wet meadows, bogs, wet woods, low fields, wet ditches.

*GEUM URBANUM* Linnaeus—Wood Avenes (Figure 11).  $2n = 21, 42$ . Fields, roadsides. From Eurasia, northern Africa.

*GEUM VERNUM* (Rafinesque) Torrey & A. Gray—Spring Avenes (Figure 11).  $2n = 42$ . Rich woods. From farther west.

*Geum virginianum* Linnaeus—Cream Avenes (Figure 11).  $2n = 42$ . Open, rich woods, thickets, rocky banks. [*G. flavum* (Porter) E.P. Bicknell]

—*Geum* hybrid—

*Geum* × *pulchrum* Fernald (*pro species*)—(Figure 11). [*G. macrophyllum* Willdenow var. *macrophyllum* × *G. rivale* Linnaeus]

*GILLENIA TRIFOLIATA* (Linnaeus) Moench—Bowman's-root (Figure 11).  $2n = 18$ . Dry woods. From farther west and south. [*PORTERANTHUS TRIFOLIATUS* (Linnaeus) Britton]

*KERRIA JAPONICA* (Linnaeus) de Candolle—Japanese Rose (Figure 11).  $2n = 18$ . Roadsides. From eastern Asia.

*MALUS BACCATA* (Linnaeus) Borkhausen—Siberian Crabapple (Figure 12).  $2n = 34$ . Roadsides, woodland margins, thickets, clearings, sandy, waste areas. From eastern and southern Asia. [*PYRUS BACCATA* Linnaeus]

*MALUS FLORIBUNDA* Siebold ex Van Houtte—Japanese Flowering Crabapple (Figure 12).  $2n = 34$ . Fields, woodland margins. From Asia.

*MALUS PRUNIFOLIA* (Willdenow) Borkhausen—Chinese Apple (Figure 12).  $2n = 34, 51$ . Waste places, roadsides, thickets, wooded terraces. From China. [*PYRUS PRUNIFOLIA* Willdenow]

*MALUS PUMILA* Miller—Common Apple (Figure 12).  $2n = 24, 34, 51, 68$ . Open woods, thickets, fields, roadsides, woodland margins, clearings. From Eurasia. [*M. DOMESTICA* – misapplied; *M. SYLVESTRIS* Miller; *PYRUS MALUS* Linnaeus]

*MALUS SIEBOLDII* (Regel) Rehder—Toringo Crabapple (Figure 12).  $2n = 51$ . Rich woods, railroads, thickets, swampy woodland margins, open, rocky knolls. From eastern Asia. [*M. SARGENTII* Rehder; *M. TORINGO* (K. Koch) Carrière; *PYRUS SIEBOLDII* Regel]

—*Malus* hybrids—

*MALUS* × *ADSTRINGENS* Zabel—(Figure 12). [*M. BACCATA* (Linnaeus) Borkhausen × *M. PUMILA* Miller]

*MALUS* × *ARNOLDIANA* (Rehder) Sargent *ex* Rehder—(Figure 12). [*M. BACCATA* (Linnaeus) Borkhausen × *M. FLORIBUNDA* Siebold *ex* Van Houtte; *PYRUS ARNOLDIANA* (Rehder) Bean]

*MALUS* × *MAGDEBURGENSIS* Hartwig—(Figure 12). [*M. PUMILA* Miller × *M. SPECTABILIS* (Aiton) Borkhausen]

*MALUS* × *MICROMALUS* Makino (*pro species*)—(Figure 12). [? *M. BACCATA* (Linnaeus) Borkhausen × *M. SPECTABILIS* (Aiton) Borkhausen]

*MALUS* × *SOULARDII* (L.H. Bailey) Britton (*pro species*)—(Figure 13). [? *M. IOENSIS* (Alph. Wood) Britton × *M. PUMILA* Miller; *PYRUS* × *SOULARDII* L.H. Bailey]

*PHOTINIA VILLOSA* (Thunberg) de Candolle—Oriental Photinia (Figure 13).  $2n = 68$ . Swamps. From eastern Asia.

*PHYSOCARPUS OPULIFOLIUS* (Linnaeus) Maximowicz—Eastern Ninebark (Figure 13).  $2n = 18$ . Rocky banks, shores, thickets, fields, roadsides, waste places. From farther west and south.

*POTENTILLA ANGLICA* Laicharding—Trailing Tormentil (Figure 13).  $2n = 28, 56$ . Fields. From Europe.

*Potentilla anserina* Linnaeus subsp. *anserina*—Common Silverweed (Figure 13).  $2n = 28, 35, 42$ . Shores. [*P. egedei* Wormskjöld *ex* Hornemann var. *groenlandica* (Trattinnick) Polunin [in part]]

*Potentilla anserina* Linnaeus subsp. *pacifica* (Howell) Rousi—Coastal Silverweed (Figure 13).  $2n = 28$ . Salt marshes, coastal seashores. [*P. egedei* Wormskjöld *ex* Hornemann var. *groenlandica* (Trattinnick) Polunin [in part]; *P. pacifica* Howell]

*POTENTILLA ARGENTEA* Linnaeus—Silvery Cinquefoil (Figure 13).  $2n = 14, 28, 42, 56$ . Dry fields, roadsides, dry, open ground. From Eurasia. [*P. ARGENTEA* var. *PSEUDOCALABRA* Th. Wolf]

*Potentilla canadensis* Linnaeus—Dwarf Cinquefoil (Figure 13).  $2n = 28$ . Dry, sandy fields, roadsides, dry, open ground, often in acidic soil. [*P. canadensis* var. *villosissima* Fernald]

*POTENTILLA GRACILIS* Douglas *ex* Hooker var. *GRACILIS*—(Figure 13).  $2n = 84$ . Dry meadows. From farther west.

*POTENTILLA INCLINATA* Villars—Grey Cinquefoil (Figure 14).  $2n = 14, 28, 35, 42, 84$ . Dry fields, roadsides, waste places. From Eurasia. [*P. CANESCENS* Besser]

*POTENTILLA INTERMEDIA* Linnaeus—Downy Cinquefoil (Figure 14).  $2n = 28, 42, 56$ . Dry fields, roadsides, waste places. From farther Eurasia.

*Potentilla litoralis* Rydberg—(Figure 14).  $2n = 28, 56$ . Dry fields, rocky outcrops, rocky shores, near coast. [*P. pectinata* Rafinesque – illegitimate name; *P. pensylvanica* Linnaeus var. *litoralis* (Rydberg) B. Boivin; *P. pensylvanica* var. *pectinata* Lepage]

*Potentilla norvegica* Linnaeus—Rough Cinquefoil (Figure 14).  $2n = 42, 56, 63, 70$ . Fields, thickets, roadsides, waste places. [*P. norvegica* var. *labradorica* (Lehmann) Fernald]

*POTENTILLA PULCHERRIMA* Lehmann—(Figure 14).  $2n = 42, \text{ca. } 70, 71, \text{ca. } 108$ . Meadows. From farther west. [*P. GRACILIS* Douglas ex Hooker var. *PULCHERRIMA* (Lehmann) Fernald]

*POTENTILLA RECTA* Linnaeus—Sulphur Cinquefoil (Figure 14).  $2n = 14, 28, 42, 35, 56$ . Dry fields, roadsides, waste places. From Eurasia, northern Africa.

*POTENTILLA REPTANS* Linnaeus—Creeping Cinquefoil (Figure 14).  $2n = 28$ . Waste places. From Eurasia, northern Africa.

*POTENTILLA RIVALIS* Nuttall—(Figure 14).  $2n = 14, 70$ . Waste places. From farther west.

*Potentilla robbinsiana* (Lehmann) Oakes ex Rydberg—(Figure 14).  $2n = 49$ . Alpine rocky slopes and flats.

*Potentilla simplex* Michaux—Old-field Cinquefoil (Figure 15).  $2n = ?$  Fields, open woods, thickets, roadsides. [*P. simplex* var. *calvescens* Fernald]

*POTENTILLA THURINGIACA* Bernhardt ex Link—(Figure 15).  $2n = 42, 56$ . Waste places, roadsides. From Eurasia.

*POTENTILLA VERA* Linnaeus—(Figure 15).  $2n = 28, 35, 42, 49, 56, 63, 70, 80$ . Grassy roadsides and banks. From Europe. [*P. TABERNAEMONTANI* Ascherson]

*POTERIDIUM ANNUM* (Nuttall) Spach—Western Burnet (Figure 15).  $2n = 14$ . Disturbed soil. From farther west. [*SANGUISORBA ANNUA* (Nuttall) Nuttall]

*Prunus americana* Marshall—Wild Plum (Figure 15).  $2n = 16$ . Fields, Roadsides, thickets, woodland margins. [*P. americana* var. *lanata* Sudworth; *P. americana* var. *mollis* (Torrey) Torrey & A. Gray]

*PRUNUS AVIUM* (Linnaeus) Linnaeus—Sweet Cherry (Figure 15).  $2n = 16$ . Roadsides, woods, woodland margins, thickets. From Eurasia.

*PRUNUS CERASIFERA* Ehrhart—Cherry Plum (Figure 15).  $2n = 16, 24$ . Roadsides, riverbanks, shores. From Eurasia.



- PRUNUS CERASUS* Linnaeus—Sour Cherry (Figure 15).  $2n = 32$ . Roadsides, thickets, woodland margins. From Eurasia.
- PRUNUS DOMESTICA* Linnaeus—Garden Plum (Figure 15).  $2n = 16, 32, 48$ . Roadsides, thickets. Probably from Eurasia.
- PRUNUS HORTULANA* L.H. Bailey—Wild Goose Plum (Figure 16).  $2n = 16$ . Woodland margins. From farther west.
- PRUNUS INSITITIA* Linnaeus—Bullace Plum (Figure 16).  $2n = 16$ . Thickets, woodland margins, roadsides, fields. From Europe. [*P. DOMESTICA* Linnaeus subsp. *INSITITIA* (Linnaeus) C.K. Schneider]
- PRUNUS MAHALEB* Linnaeus—Perfumed Cherry (Figure 16).  $2n = 16$ . Railroads, roadsides, woodland borders, fields. From Eurasia, northern Africa.
- Prunus maritima* Marshall—Beach Plum (Figure 16).  $2n = 16$ . Roadsides, dunes, sandy fields, other sandy sites, near seacoast. [*P. maritima* var. *graveoli* (Small) G.J. Anderson; *P. graveoli* Small]
- Prunus nigra* Aiton—Canada Plum (Figure 16).  $2n = 16$ . Roadsides, thickets, waste places, woodland margins, stream banks.
- Prunus pensylvanica* Linnaeus f.—Pin Cherry (Figure 16).  $2n = 16$ . Dry, open sandy soil, recent burns, dry, open woods and clearings.
- PRUNUS PERSICA* (Linnaeus) Batsch—Peach (Figure 16).  $2n = 16$ . Roadsides, thickets. From China.
- Prunus pumila* Linnaeus var. *depressa* (Pursh) Bean—Dwarf Sand Cherry (Figure 16).  $2n = 16$ . Sandy, gravelly or rocky river shores, beaches. [*P. depressa* Pursh]
- Prunus pumila* Linnaeus var. *susquehanae* (Willdenow) H. Jaeger—Appalachian Sand Cherry (Figure 16).  $2n = 16$ . Sandy barrens, beaches, clearings, roadsides and fields, dry woods and ledges. [*P. pumila* var. *cuneata* (Rafinesque) L.H. Bailey; *P. susquehanae* Willdenow]
- Prunus serotina* Ehrhart var. *serotina*—Black Cherry (Figure 17).  $2n = 32$ . Thickets, roadsides, wood margins, dry woods, waste places.
- PRUNUS SERRULATA* Lindley—Japanese Flowering Cherry (Figure 17).  $2n = 16$ . Mixed woods, roadsides. From Eurasia.
- PRUNUS SPINOSA* Linnaeus—Blackthorn (Figure 17).  $2n = 32, 40, 48$ . Fields, pond shores. From Eurasia.
- Prunus umbellata* Elliott—Sloe Plum (Figure 17).  $2n = ?$  Roadsides, sandy bottoms, river terraces, fields, rocky coves. [*P. alleghaniensis* Porter]
- Prunus virginiana* Linnaeus var. *virginiana*—Choke Cherry (Figure 17).  $2n = 16, 26, 32$ . Thickets, roadsides, woodland margins.

—*Prunus* hybrid—

*Prunus serotina* Ehrhart var. *serotina* × *P. virginiana* Linnaeus var. *virginiana*—(Figure 17).

*PYRUS CALLERYANA* Decaisne—Callery Pear (Figure 17).  $2n = 34$ . Shrubby thickets, ditches. From eastern Asia.

*PYRUS COMMUNIS* Linnaeus—Common Pear (Figure 17).  $2n = 34$ . Roadsides, fields, thickets, woodland margins. Probably from Eurasia.

*RHODOTYPOS SCANDENS* (Thunberg) Makino—Jetbead (Figure 17).  $2n = 18$ . Waste places, dry, oak-hickory woods, roadsides. From eastern Asia.

*Rosa acicularis* Lindley subsp. *sayi* (Schweinitz) W.H. Lewis—(Figure 18).  $2n = 42, 49, 56$ . Railroads, shores, thickets, rocky slopes. [*R. acicularis* var. *bourgeauiana* Crépín]

*ROSA ARKANSANA* Porter—Prairie Rose (Figure 18).  $2n = 28$ . Railroads. From farther west.

*Rosa blanda* Aiton—Smooth Rose (Figure 18).  $2n = 14$ . Shores, riverbanks, meadows, thickets, railroads. [*R. blanda* var. *glabra* Crépín; *R. johannensis* Fernald]

*ROSA CANINA* Linnaeus—Dog Rose (Figure 18).  $2n = 28, 35$ . Roadsides, thickets, fields, dry banks.

*Rosa carolina* Linnaeus subsp. *carolina*—Pasture Rose (Figure 18).  $2n = 28$ . Dry pastures, thickets, thin woods, roadsides, other dry, sandy, rocky or open habitats. [*R. carolina* var. *grandiflora* (Baker) Rehder; *R. carolina* var. *villosa* (Best) Rehder; *R. humilis* Marshall]

*ROSA CINNAMOMEA* Linnaeus—Cinnamon Rose (Figure 18).  $2n = 14$ . Roadsides, fields, fencerows, clearings. From Eurasia. [*R. MAJALIS* Hermann]

*ROSA GALLICA* Linnaeus—French Rose (Figure 18).  $2n = 28$ . Roadside thickets, waste places. From Eurasia.

*ROSA GLAUCA* Pourret—(Figure 18).  $2n = 28$ . Roadsides, thickets. From Europe. [*R. FERRUGINEA* Villars; *R. RUBRIFOLIA* Villars]

*ROSA LUCIAE* Franchet & Rochebrune ex Crépín—Memorial Rose (Figure 18).  $2n = 14$ . Thickets, woodland margins. From eastern Asia. [*R. WICHURALANA* Crépín]

*ROSA MOLLIS* Smith—(Figure 19).  $2n = 28$ . Roadsides. From Eurasia.

*ROSA MULTIFLORA* Thunberg—(Figure 19).  $2n = 14, 21$ . Roadsides, woodland margins, clearings, thickets, waste places. From eastern Asia.

*Rosa nitida* Willdenow—Northeastern Rose (Figure 19).  $2n = 14$ . Swamps, bogs, pond shores, wet thickets, in acid soil.

*Rosa palustris* Marshall—Swamp Rose (Figure 19).  $2n = 14$ . Swamps, meadows, pastures, wet thickets, shores.

*ROSA RUBIGINOSA* Linnaeus var. *RUBIGINOSA*—Sweetbrier (Figure 19).  $2n = 35$ . Roadsides, fields, thickets, clearings. From Eurasia. [*R. EGLANTERIA* Linnaeus – ambiguous name; *R. MICRANTHA* Borrer ex Smith]

*ROSA RUGOSA* Thunberg—Beach Rose (Figure 19).  $2n = 14, 28$ . Sandy, open soil, often near salt water, roadsides, dunes. From eastern Asia.

*ROSA SETIGERA* Michaux—Climbing Rose (Figure 19).  $2n = 14$ . Roadsides, fields, woods, hillsides. From farther west and south. [*R. SETIGERA* var. *TOMENTOSA* Torrey & A. Gray]

*ROSA SHERARDII* Davies—(Figure 19).  $2n = 28, 35, 42$ . Roadsides, pastures. From Europe.

*ROSA SPINOSISSIMA* Linnaeus—Burnet Rose (Figure 19).  $2n = 28$ . Roadsides, thickets, fields. From Eurasia. [*R. PIMPINELLIFOLIA* Linnaeus]

*Rosa virginiana* Miller—(Figure 20).  $2n = 28$ . Thickets, meadows, swamps, shores, clearings, roadsides. [*R. virginiana* var. *lamprophylla* Rehder; *R. lucida* Ehrhart]

—*Rosa* hybrids—

*Rosa carolina* Linnaeus subsp. *carolina* × *R. palustris* Marshall—(Figure 20).

*Rosa carolina* Linnaeus subsp. *carolina* × *R. RUBIGINOSA* Linnaeus var. *RUBIGINOSA*—(Figure 20).

*ROSA* × *CENTIFOLIA* Linnaeus (*pro species*)—(Figure 20). [*R. GALLICA* Linnaeus × ?]

*ROSA* × *FRANCOFURTANA* Münchhausen (*pro species*)—(Figure 20). [*R. CINNAMOMEA* Linnaeus × *R. GALLICA* Linnaeus]

*Rosa nitida* Willdenow × *R. palustris* Marshall—(Figure 20).

*Rosa nitida* Willdenow × *R. virginiana* Miller—(Figure 20).

*Rosa* × *novae-angliae* W.H. Lewis—(Figure 20). [*R. carolina* Linnaeus subsp. *carolina* × *R. virginiana* Miller]

*Rosa palustris* Marshall × *R. virginiana* Miller—(Figure 20).

#### *Rubus* taxonomy

Due to the significant diversity of taxonomic treatments for this genus over the years, particularly for the large subgenus *Eubatus*, and the complicated reproductive mechanisms known to occur (hybridization, polyploidy, apomixis), the listing here largely follows the intensive New England study for subgenus *Eubatus* of Hodgdon and Steele (1966, 1970). The work of H. Davis, A. Fuller and T. Davis (1967, 1968a, 1968b, 1969a, 1969b, 1970, 1982), H. Davis (1990), Gleason and Cronquist (1991), and an unpublished 2009 draft by L.A. Alice, D.H. Goldman, G. Moore and J.A. Macklin for the Flora of North America have been used to help place some names in synonymy.

- Rubus allegheniensis* Porter—Common Highbush Blackberry (Figure 21).  $2n = 14, 21, 28$ . Roadsides, fields, clearings, woodland margins, thickets. [*R. allegheniensis* var. *gravesii* (Fernald) Fernald; *R. allegheniensis* var. *plausus* L.H. Bailey; *R. allegheniensis* var. *populifolius* Fernald; *R. fernaldianus* L.H. Bailey; ?*R. floricomus* Blanchard; *R. pugnax* L.H. Bailey; *R. saltuensis* L.H. Bailey]
- Rubus amicalis* Blanchard—(Figure 21).  $2n = ?$  Fields, thickets, waste places, woods, bases of ledges, moist, sphagnum soil. [*R. amabilis* Blanchard not Focke – illegitimate name; *R. elegantulus* Blanchard not Forster – illegitimate name]
- Rubus arenicola* Blanchard—Sand Dewberry (Figure 21).  $2n = ?$  Dry fields, roadsides, open plains, ledges, especially in dry, open, sandy soil. [*R. brameritii* Rydberg; *R. curtipes* L.H. Bailey; ?*R. fraternalis* L.H. Bailey; *R. janssonii* L.H. Bailey; *R. obsessus* L.H. Bailey; *R. pauper* L.H. Bailey; *R. perpauper* L.H. Bailey; *R. prosper* L.H. Bailey]
- Rubus argutus* Link—Southern Blackberry (Figure 21).  $2n = 14, 21$ . Thickets, woodland and bog margins. [*R. blakei* L.H. Bailey; *R. jugosus* L.H. Bailey; *R. paludivagus* Fernald]
- RUBUS BIFRONS* Vest—Armenian Blackberry (Figure 21).  $2n = 28$ . Roadsides, waste places. From Eurasia. [*R. ARMENIACUS* Focke; *R. DISCOLOR* – misapplied]
- Rubus canadensis* Linnaeus—Smooth Blackberry (Figure 21).  $2n = 14, 21$ . Moist thickets, clearings in northern hardwood forests, woodland margins, cliff bases.
- Rubus chamaemorus* Linnaeus—Cloudberry (Figure 21).  $2n = 56$ . *Sphagnum* bogs, heaths, often at high elevation.
- Rubus cuneifolius* Pursh—Sand Blackberry (Figure 21).  $2n = 14, 21, 28$ . Sandy or rocky, dry open soil on coastal plain. [*R. cuneifolius* var. *spiniceps* L.H. Bailey]
- Rubus enslenii* Trattinnick—(Figure 21).  $2n = ?$  Dry, open, mostly oak-hickory woods, ledges, thickets. [*R. baileyanus* Britton]
- Rubus flagellaris* Willdenow—Common Dewberry (Figure 22).  $2n = 28, 56, 63$ . Dry fields, sandy areas, openings, ledges, thicket borders, roadsides. [? *R. eflagellaris* L.H. Bailey; *R. felix* L.H. Bailey; ?*R. ithacanus* L.H. Bailey; *R. maniseensis* L.H. Bailey; ?*R. particeps* L.H. Bailey; *R. villosus* – misapplied]
- Rubus frondosus* Bigelow—Yankee Blackberry (Figure 22).  $2n = 14, 21, 42$ . Thickets, fields, roadsides, woodland borders. [*R. bellobatus* L.H. Bailey; *R. insulamus* L.H. Bailey; *R. multispinus* Blanchard; *R. recurvans* Blanchard; *R. rossbergianus* Blanchard]
- Rubus hispidus* Linnaeus—Swamp Dewberry (Figure 22).  $2n = 14, 21, 28, 35, 56$ . Fields, open woods (specially pine), gravel pits, ditches, swamps, sphagnum soil, *Sphagnum* bogs, meadows. [*R. hispidus* var. *obovatis* (Michaux) Fernald; *R. cubitans* Blanchard; ?*R. novanglicus* L.H. Bailey; *R. pervarnus* (L.H. Bailey) L.H. Bailey; *R. spiculosus* Fernald]
- RUBUS IDAEUS* Linnaeus subsp. *IDAEUS*—European Red Raspberry (Figure 22).  $2n = 14, 21, 28, 42$ . Roadsides, fields, thickets. From Eurasia.

- Rubus idaeus* Linnaeus subsp. *strigosus* (Michaux) Focke—Wild Red Raspberry (Figure 22).  $2n = 14$ , 21, 28. Clearings, fields, roadsides, dry, open woods, damp thickets, woodland borders. [*R. idaeus* var. *canadensis* Richardson ex Fernald; *R. idaeus* var. *egglestonii* (Blanchard) Fernald; *R. idaeus* var. *heterolasus* Fernald]
- RUBUS ILLECEBROSUS* Focke—Strawberry Raspberry (Figure 22).  $2n = 14$ . Woods, disturbed sites. From Japan.
- Rubus jaysmithii* L.H. Bailey—(Figure 22).  $2n = ?$  Dry fields, sandy areas, openings, ledges, thicket borders, roadsides. [*R. multiflorus* L.H. Bailey; *R. scaberrimus* L.H. Bailey; *R. tetriflorus* L.H. Bailey]
- RUBUS LACINIATUS* Willdenow—Cut-leaved Blackberry (Figure 22).  $2n = 28$ . Roadsides, sandy soil near beaches, railroads, fields, waste places. Probably from Europe.
- Rubus occidentalis* Linnaeus—Black Raspberry (Figure 22).  $2n = 14$ . Clearings, thickets, woodland borders, fields.
- Rubus odoratus* Linnaeus—Purple-flowering Raspberry (Figure 23).  $2n = 14$ . Woodland borders, open woods, thickets, roadsides, rocky slopes.
- RUBUS PARVIFOLIUS* Linnaeus—Japanese Raspberry (Figure 23).  $2n = 14$ . Waste places. From eastern Asia, Australia. [*R. TRIPHYLLUS* Thunberg]
- Rubus pensilvanicus* Poir.—(Figure 23).  $2n = 28$ . Thickets, roadsides, swamps, woods, woodland borders, clearings. [*R. amnicola* Blanchard; *R. andrewstanus* Blanchard; *R. avipes* L.H. Bailey; *R. barbarus* L.H. Bailey; *R. conanicutensis* L.H. Bailey; *R. facetus* L.H. Bailey; ?*R. gnarus* L.H. Bailey; *R. insons* L.H. Bailey; ?*R. latens* L.H. Bailey; *R. orarius* Blanchard; *R. ostryfolius* Rydberg not Gandoger – illegitimate name; *R. pergratus* Blanchard; *R. philadelphicus* Blanchard]
- RUBUS PHOENICOLASIUS* Maximowicz—Wineberry (Figure 23).  $2n = 14$ . Roadsides, thickets, open woods, disturbed, open areas. From eastern Asia.
- Rubus pubescens* Rafinesque—Dwarf Raspberry (Figure 23).  $2n = 14$ . Damp woods and slopes, swamps, low thickets, rocky shores, sandy banks. [*R. pubescens* var. *pilosifolius* A.F. Hill]
- Rubus recurvicaulis* Blanchard—Arching Dewberry (Figure 23).  $2n = 14, 35, 42$ . Fields, railroads, roadsides, other dry or gravelly, open soil. [*R. aptatus* L.H. Bailey; *R. arundelamus* Blanchard var. *arundelamus*; *R. arundelamus* var. *jeckylamus* (Blanchard) L.H. Bailey; *R. plicatifolius* Blanchard; *R. positivus* L.H. Bailey; *R. usus* L.H. Bailey]
- Rubus repens* (Linnaeus) Kuntze—Dewdrop (Figure 23).  $2n = 14$ . Rich, moist woods, swamps. [*R. dalibarda* Linnaeus – illegitimate name; *Dalibarda repens* Linnaeus]
- RUBUS RORIBACCUS* (L.H. Bailey) Rydberg—Lucretia Dewberry (Figure 23).  $2n = 49$ . Dry woods. From farther west.

*Rubus semisetosus* Blanchard—Swamp Blackberry (Figure 23).  $2n = ?$  Swales, swampy thickets, dryish meadows. [*R. ascendens* Blanchard; *R. bigelovianus* L.H. Bailey; *R. hispidoides* L.H. Bailey; *R. orthius* (L.H. Bailey) L.H. Bailey; *R. perinivius* L.H. Bailey]

*Rubus setosus* Bigelow—Bristly Blackberry (Figure 24).  $2n = 14, 21$ . Alluvial plains, grassy swamps, swales, damp thickets, waste places. [*R. dissimilis* L.H. Bailey; *R. groutianus* Blanchard; *R. lawrencei* L.H. Bailey; *R. notatus* L.H. Bailey]

*Rubus vermontanus* Blanchard—(Figure 24).  $2n = ?$  Clearings, sterile fields, thickets, cliff bases. [*R. abbrevians* Blanchard; *R. junceus* Blanchard; *R. mixtus* L.H. Bailey; *R. navis* L.H. Bailey; *R. regionalis* (L.H. Bailey) L.H. Bailey; *R. tardatus* Blanchard]

—*Rubus* hybrids—

*Rubus allegheniensis* Porter  $\times$  *R. amicalis* Blanchard—(Figure 24).

*Rubus allegheniensis* Porter  $\times$  *R. canadensis* Linnaeus—(Figure 24).

*Rubus allegheniensis* Porter  $\times$  *R. flagellaris* Willdenow—(Figure 24).

*Rubus allegheniensis* Porter  $\times$  *R. frondosus* Bigelow—(Figure 24).

*Rubus allegheniensis* Porter  $\times$  *R. hispidus* Linnaeus—(Figure 24). [*R. biformispinus* Blanchard; *R. invisus* (L.H. Bailey) Britton; *R. jactus* L.H. Bailey; *R. laevior* (L.H. Bailey) Fernald; *R. permixtus* Blanchard; *R. sanfordii* L.H. Bailey]

*Rubus allegheniensis* Porter  $\times$  *R. pensilvanicus* Poiret—(Figure 24). [*R. alumnus* L.H. Bailey; *R. paulus* L.H. Bailey; *R. rosa* L.H. Bailey]

*Rubus allegheniensis* Porter  $\times$  *R. recurvicaulis* Blanchard—(Figure 24).

*Rubus allegheniensis* Porter  $\times$  *R. setosus* Bigelow—(Figure 25). [*R. aculiferus* Fernald; *R. frondosus* Blanchard; *R. glandicaulis* Blanchard; *R. montpelierensis* Blanchard ex L.H. Bailey; *R. scleratus* Brainerd ex Fernald]

*Rubus allegheniensis* Porter  $\times$  *R. vermontanus* Blanchard—(Figure 25). [*R. flavinatus* Blanchard; *R. rarus* L.H. Bailey]

*Rubus amicalis* Blanchard  $\times$  *R. frondosus* Bigelow—(Figure 25).

*Rubus amicalis* Blanchard  $\times$  *R. jaysmithii* L.H. Bailey—(Figure 25).

*Rubus amicalis* Blanchard  $\times$  *R. recurvicaulis* Blanchard—(Figure 25).

*Rubus amicalis* Blanchard  $\times$  *R. setosus* Bigelow—(Figure 25).

*Rubus amicalis* Blanchard  $\times$  *R. vermontanus* Blanchard—(Figure 25). [*R. multiflorus* L.H. Bailey]

*Rubus canadensis* Linnaeus  $\times$  *R. amicalis* Blanchard—(Figure 25).

- Rubus canadensis* Linnaeus × *R. frondosus* Bigelow—(Figure 25).
- Rubus canadensis* Linnaeus × *R. pensilvanicus* Poirét—(Figure 26).
- Rubus canadensis* Linnaeus × *R. setosus* Bigelow—(Figure 26).
- Rubus canadensis* Linnaeus × *R. vermontanus* Blanchard—(Figure 26).
- Rubus enslenii* Trattinnick × *R. frondosus* Bigelow—(Figure 26).
- Rubus enslenii* Trattinnick × *R. pensilvanicus* Poirét—(Figure 26).
- Rubus enslenii* Trattinnick × *R. recurvicaulis* Blanchard—(Figure 26).
- Rubus flagellaris* Willdenow × *R. frondosus* Bigelow—(Figure 26).
- Rubus flagellaris* Willdenow × *R. hispidus* Linnaeus—(Figure 26). [*R. mamensis* L.H. Bailey]
- Rubus flagellaris* Willdenow × *R. recurvicaulis* Blanchard—(Figure 26).
- Rubus frondosus* Bigelow × *R. hispidus* Linnaeus—(Figure 27).
- Rubus frondosus* Bigelow × *R. jaysmithii* L.H. Bailey—(Figure 27).
- Rubus frondosus* Bigelow × *R. recurvicaulis* Blanchard—(Figure 27).
- Rubus frondosus* Bigelow × *R. semisetosus* Blanchard—(Figure 27).
- Rubus frondosus* Bigelow × *R. setosus* Bigelow—(Figure 27).
- Rubus frondosus* Bigelow × *R. vermontanus* Blanchard—(Figure 27).
- Rubus hispidus* Linnaeus × *R. jaysmithii* L.H. Bailey—(Figure 27).
- Rubus hispidus* Linnaeus × *R. recurvicaulis* Blanchard—(Figure 27).
- Rubus hispidus* Linnaeus × *R. semisetosus* Blanchard—(Figure 27).
- Rubus hispidus* Linnaeus × *R. setosus* Bigelow—(Figure 28). [*R. adjacens* Fernald; *R. alter* L.H. Bailey; *R. blanchardianus* (L.H. Bailey) L.H. Bailey; *R. harmonicus* L.H. Bailey; *R. jacens* Blanchard; *R. pudens* L.H. Bailey; *R. segnis* L.H. Bailey; *R. tholiformis* Fernald; *R. trifrons* Blanchard; *R. vigoratus* L.H. Bailey]
- Rubus hispidus* Linnaeus × *R. setosus* Bigelow × *R. vermontanus* Blanchard—(Figure 28).
- Rubus hispidus* Linnaeus × *R. vermontanus* Blanchard—(Figure 28).
- Rubus* × *neglectus* Peck (*pro species*)—(Figure 28). [*R. idaeus* Linnaeus subsp. *strigosus* (Michaux) Focke × *R. occidentalis* Linnaeus]

*Rubus pensilvanicus* Poiret × *R. recurvicaulis* Blanchard—(Figure 28).

*Rubus recurvicaulis* Blanchard × *R. setosus* Bigelow—(Figure 28). [*R. arcuans* Fernald & H. St. John; *R. bicknellii* L.H. Bailey; *R. multiflorus* Blanchard; *R. provincialis* L.H. Bailey]

*Rubus recurvicaulis* Blanchard × *R. vermontanus* Blanchard—(Figure 28). [*R. severus* Brainerd ex Fernald]

*Rubus semisetosus* Blanchard × *R. setosus* Bigelow—(Figure 28).

*Rubus setosus* Bigelow × *R. vermontanus* Blanchard—(Figure 28). [*R. gulosus* L.H. Bailey; *R. parlinii* L.H. Bailey; *R. univocus* L.H. Bailey]

*Sanguisorba canadensis* Linnaeus—American Burnet (Figure 29).  $2n = 28$ . Meadows, swamps, low ground, sphagnum soils.

*SANGUISORBA MINOR* Scopoli subsp. *MURICATA* (Spach ex Bonnier & Layens) Briquet—Fodder Burnet (Figure 29).  $2n = 28, 56$ . Old fields, roadsides, quarry ledges, waste places. From Eurasia, northern Africa. [*S. MINOR* Scopoli subsp. *BALEARICA* (Bourgeau ex Nyman) Muñoz Garmendia & C. Navarro]

*SANGUISORBA OFFICINALIS* Linnaeus—Great Burnet (Figure 29).  $2n = 28, 42, 56$ . Roadsides, fields, thickets. From Eurasia, northwestern North America.

*Sibbaldia procumbens* Linnaeus—(Figure 29).  $2n = 14$ . Headwalls of alpine ravines.

*Sibbaldopsis tridentata* (Aiton) Rydberg—Three-toothed Cinquefoil (Figure 29).  $2n = 28$ . Dry, open, rocky, gravelly or sandy, sterile soil, clefts in ledges, often at high altitudes. [*Potentilla tridentata* Aiton]

*SORBARIA SORBIFOLIA* (Linnaeus) A. Braun—False Spiraea (Figure 29).  $2n = 36$ . Roadsides, waste places. From eastern Asia.

—*Sorbaronia* hybrids—

× *SORBARONIA FALLAX* (C.K. Schneider) C.K. Schneider—(Figure 29). [*Aronia melanocarpa* (Michaux) Elliott × *SORBUS AUCUPARIA* Linnaeus; *PYRUS* × *FALLAX* (C.K. Schneider) Fernald]

× *SORBARONIA HYBRIDA* (Moench) C.K. Schneider—(Figure 29). [*Aronia arbutifolia* (Linnaeus) Persoon × *SORBUS AUCUPARIA* Linnaeus; *ARONIA HYBRIDA* (Moench) Zabel; *PYRUS HYBRIDA* Moench; *SORBUS* × *HYBRIDA* (Moench) C.K. Schneider not Linnaeus – illegitimate name]

× *Sorbaronia jackii* Rehder—(Figure 29). [*Aronia* × *prunifolia* (Marshall) Rehder × *Sorbus americana* Marshall; *Pyrus* × *jackii* (Rehder) Fernald]

× *Sorbaronia monstrosa* (Zabel) C.K. Schneider—(Figure 30). [*Aronia* × *arbutifolia* (Linnaeus) Persoon × *Sorbus americana* Marshall]



- \* *Sorbaronia sorbifolia* (Poiret) C.K. Schneider—(Figure 30). [*Aronia melanocarpa* (Michaux) Elliott \* *Sorbus americana* Marshall; *Aronia sargentii* (Dippel) Zabel; *Pyrus* \* *mixta* Fernald; *Sorbus* \* *sargentii* Dippel; *Sorbus* \* *sorbifolia* (Poiret) Hedlund]

*Sorbus americana* Marshall—American Mountain-ash (Figure 30).  $2n = 34$ . Cool, moist woods, mountain slopes. [*Pyrus americana* (Marshall) Sprengel]

*SORBUS AUCUPARIA* Linnaeus—European Mountain-ash (Figure 30).  $2n = 34$ . Woods, fields, roadsides, woodland borders, thickets. From Eurasia. [*PYRUS AUCUPARIA* (Linnaeus) Gaertner]

*Sorbus decora* (Sargent) C.K. Schneider—Northern Mountain-ash (Figure 30).  $2n = 34$ . Wet woods, high mountain slopes, freshwater shores. [*S. decora* var. *groenlandica* (C.K. Schneider) G.N. Jones; *Pyrus decora* (Sargent) Hyland; *P. decora* var. *groenlandica* (C.K. Schneider) Fernald]

*SORBUS INTERMEDIA* (Ehrhart) Persoon—Swedish Whitebeam (Figure 30).  $2n = 68$ . Roadsides. From Europe. [*PYRUS INTERMEDIA* Ehrhart]

*Spiraea alba* Du Roi—Hairy Meadowsweet (Figure 30).  $2n = 36$ . Swamps, low, moist, open ground.

*SPIRAEA CHAMAEDRYFOLIA* Linnaeus—Germander Meadowsweet (Figure 30).  $2n = 18, 32, 36$ . Roadsides. From Eurasia. [*S. CHAMAEDRYFOLIA* var. *ULMIFOLIA* (Scopoli) Maximowicz]

*SPIRAEA HYPERICIFOLIA* Linnaeus subsp. *OBOVATA* (Waldstein & Kitaibel ex Willdenow) Dostál—Iberian Spiraea (Figure 30).  $2n = ?$ . Roadside in dry calcareous, sandy soil. From Europe.

*SPIRAEA JAPONICA* Linnaeus f. var. *FORTUNEI* (Planchon) Rehder—Japanese Spiraea (Figure 31).  $2n = 36$ . Roadsides, railroads, thickets. From eastern Asia.

*Spiraea latifolia* (Aiton) Borkhausen—Smooth Meadowsweet (Figure 31).  $2n = 36$ . Low, open ground. [*S. alba* Du Roi var. *latifolia* (Aiton) H. E. Ahles]

*SPIRAEA NIPPONICA* Maximowicz—(Figure 31).  $2n = ?$ . Shrubland at edge of lowland plain. From Japan.

*SPIRAEA PRUNIFOLIA* Siebold & Zuccarini—Bridalwreath Spiraea (Figure 31).  $2n = 18$ . Roadsides, waste places, rocky knolls. From eastern Asia.

*Spiraea septentrionalis* (Fernald) Å. Löve & D. Löve—Alpine Meadowsweet (Figure 31).  $2n = 54$ . Alpine areas. [*S. alba* Du Roi var. *septentrionalis* (Fernald) Fosberg; *S. latifolia* (Aiton) Borkhausen var. *septentrionalis* Fernald]

*SPIRAEA THUNBERGII* Siebold ex Blume—Baby's-breath Spiraea (Figure 31).  $2n = 18$ . Dry, sandy, fields, open woods, clearings, roadsides, shores. From China.

*Spiraea tomentosa* Linnaeus—Hardhack (Figure 31).  $2n = 24, 36$ . Low, open, often moist, acidic soil, fields. [*S. tomentosa* var. *rosea* (Rafinesque) Fernald]

—*Spiraea hybrid*—

*SPIRAEA* × *VANHOUTTEI* (Briot) Carrière (*pro species*)—(Figure 31). [parentage uncertain; origin from cultivation]

*Waldsteiria fragarioides* (Michaux) Trattinnick—Barren Strawberry (Figure 31).  $2n = 14, 21, 42$ . Rich, usually dry, woods, thickets, clearings, fields, roadsides. [*Geum fragarioides* (Michaux) Smedmark]

## ACKNOWLEDGMENTS

We thank the curators and directors of the herbaria of the New England Botanical Club, the Harvard University Herbaria, the University of Massachusetts, and the University of Vermont for allowing access to their collections. For the University of Maine and University of Connecticut herbaria we used their exceptional online databases of specimens. We are grateful also to Karen Searcy for facilitating access to the herbarium and to the notebooks of Harry E. Ahles at the University of Massachusetts (Amherst) and to Roberta Lombardi for kindly answering requests for information after our visit. David Barrington assisted with our access to the Pringle Herbarium of the University of Vermont. James Hinds generously checked information on voucher specimens at the University of Maine (Orono). The following persons also checked certain records for us at their respective institutions: Janet Sullivan, Lauren Sopher, Robert Capers, Patrick Sweeney, and Craig D. Layne. John T. Kartesz and Misako Nishino generously provided the latest draft version of the Floristic Synthesis of North America, which was consulted for reports of occurrence and the sources of such reports. Erika Sonder kindly assisted with reviewing specimens at the Harvard University Herbaria. We thank Kanchi Gandhi for nomenclatural advice.

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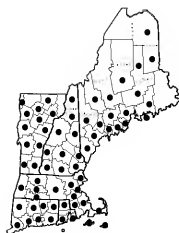
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Figure 1 Key map for counties of the New England states (and Mt Desert Island, Maine; Block Island, Rhode Island; arbitrary divisions of larger Maine counties and of Coos County, New Hampshire).



*AGRIMONIA EUPATORIA*



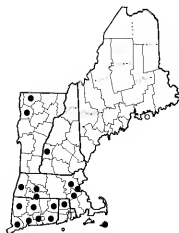
*Agrimonia gryposepala*



*Agrimonia microcarpa*



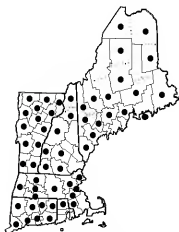
*Agrimonia parviflora*



*Agrimonia pubescens*



*Agrimonia rostellata*



*Agrimonia striata*

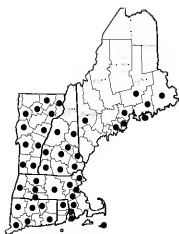


*ALCHEMILLA FILICAULIS*  
subsp. *VESTITA*

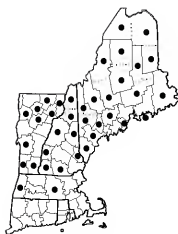


*ALCHEMILLA MONTICOLA*

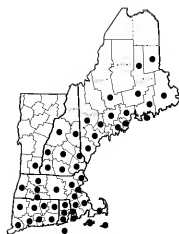
Figure 2 Distribution maps.



*Amelanchier arborea*



*Amelanchier bartramiana*



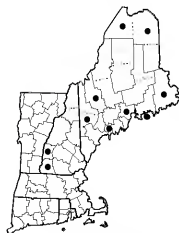
*Amelanchier canadensis*  
var. *canadensis*



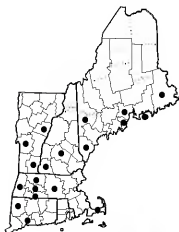
*Amelanchier gaspensis*



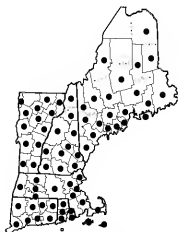
*Amelanchier humilis*



*Amelanchier interior*



*Amelanchier intermedia*

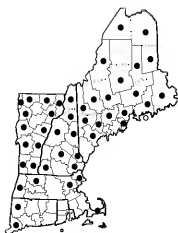


*Amelanchier laevis*

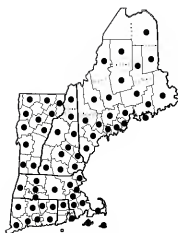


*Amelanchier nantucketensis*

Figure 3 Distribution maps.



*Amelanchier sanguinea*



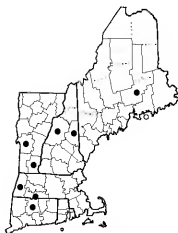
*Amelanchier spicata*



*Amelanchier arborea*  
*X A. bartramiana*



*Amelanchier arborea*  
*X A. canadensis var. canadensis*



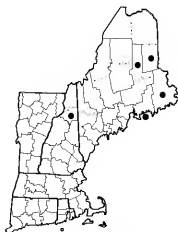
*Amelanchier arborea*  
*X A. laevis*



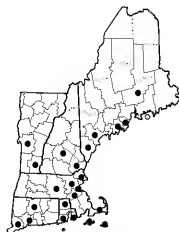
*Amelanchier arborea*  
*X A. spicata*



*Amelanchier bartramiana*  
*X A. canadensis var. canadensis*



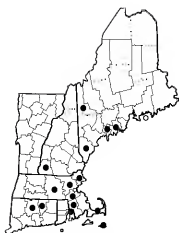
*Amelanchier bartramiana*  
*X A. spicata*



*Amelanchier canadensis var. canadensis*  
*X A. laevis*

Figure 4. Distribution maps.





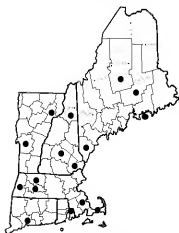
*Amelanchier canadensis* var. *canadensis*  
*X A. spicata*



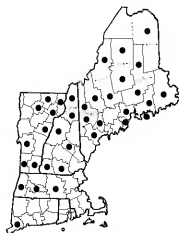
*Amelanchier humilis*  
*X A. laevis*



*Amelanchier laevis*  
*X A. sanguinea*



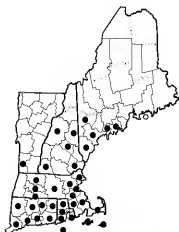
*Amelanchier laevis*  
*X A. spicata*



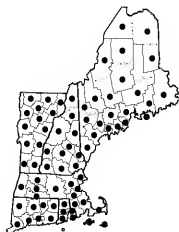
*Amelanchier X neglecta*



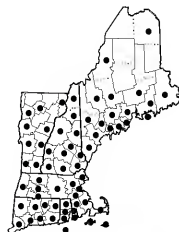
*Amelanchier sanguinea*  
*X A. spicata*



*Aronia arbutifolia*

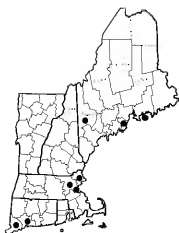


*Aronia melanocarpa*



*Aronia X prunifolia*

Figure 5 Distribution maps.



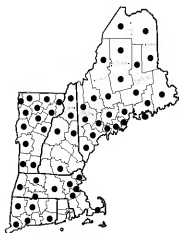
*ARUNCUS DIOICUS*  
var. *DIOICUS*



*CHAENOMELES JAPONICA*



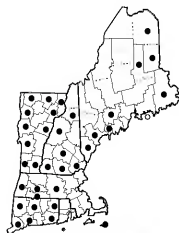
*CHAENOMELES SPECTIOSA*



*Comarum palustre*



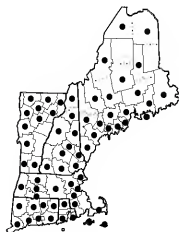
*COTONEASTER DIVARICATUS*



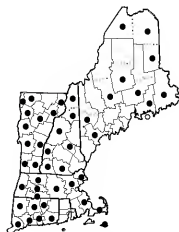
*Crataegus brainerdii*



*Crataegus calpodendron*

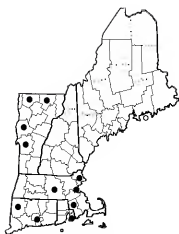


*Crataegus chrysocarpa*

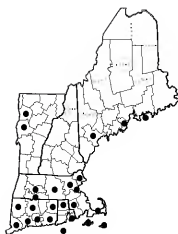


*Crataegus coccinea*

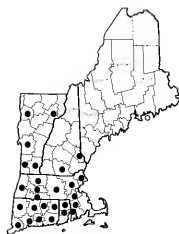
Figure 6. Distribution maps.



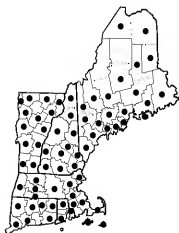
*Crataegus coccinoides*



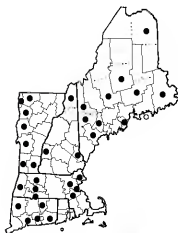
*Crataegus crus-galli*



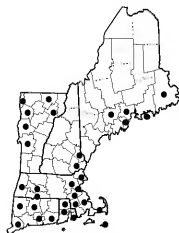
*Crataegus intricata*



*Crataegus macrocarpa*



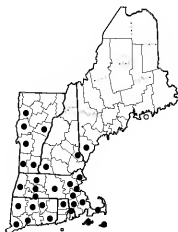
*Crataegus mollis*



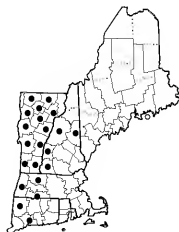
*CRATAEGUS MONOGYNA*



*CRATAEGUS PHAENOPYRUM*

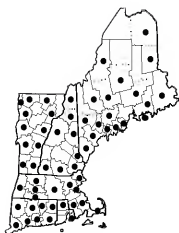


*Crataegus pruinosa*



*Crataegus punctata*

Figure 7. Distribution maps.



*Crataegus succulenta*



*Crataegus anomala*



*Crataegus X haemacarpa*



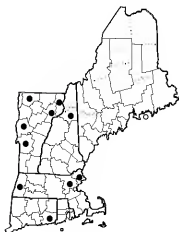
*Crataegus X hudsonica*



*Crataegus X ideae*



*Crataegus X kennedyi*



*Crataegus X lucorum*



*Crataegus X pilosa*



*Crataegus X spatiosa*

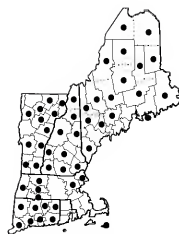
Figure 8. Distribution maps.



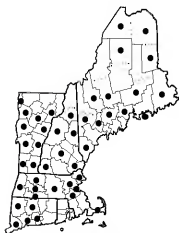
*Crataegus X websteri*



*CYDONIA OBLONGA*



*Dasiphora fruticosa*



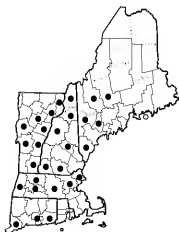
*Drymocallis arguta*



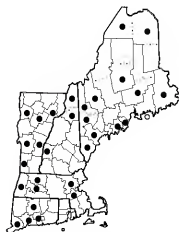
*DUCHESNEA INDICA*  
var. *INDICA*



*EXOCHORDA RACEMOSA*



*FILIPENDULA RUBRA*

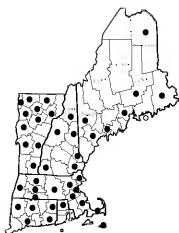


*FILIPENDULA ULMARIA*

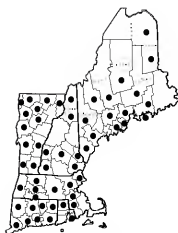


*FILIPENDULA VULGARIS*

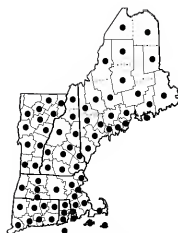
Figure 9 Distribution maps.



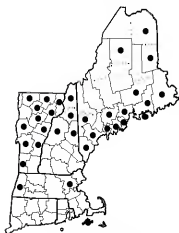
*FRAGARIA VESCA*  
subsp. *VESCA*



*Fragaria vesca*  
subsp. *americana*



*Fragaria virginiana*  
subsp. *virginiana*



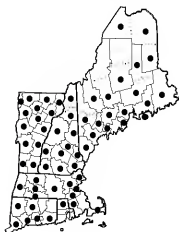
*Fragaria virginiana*  
subsp. *glauca*



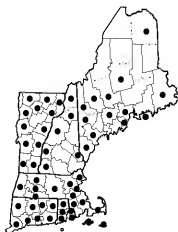
*FRAGARIA VIRGINIANA*  
subsp. *GRAYANA*



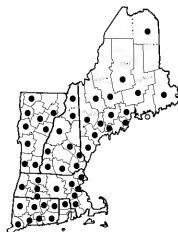
*FRAGARIA XANANASSA*



*Geum alepicum*

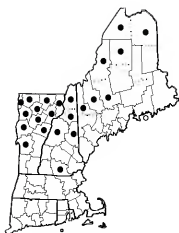


*Geum canadense*



*Geum laciniatum*

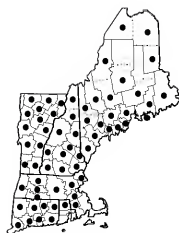
Figure 10 Distribution maps



*Geum macrophyllum*  
var. *macrophyllum*



*Geum peckii*



*Geum rivale*



GEUM URBANUM



GEUM VERNUM



*Geum virginianum*



*Geum x pulchrum*

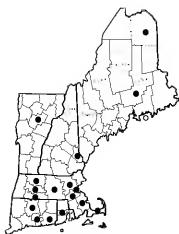


GILLENIA TRIFOLIATA



KERRIA JAPONICA

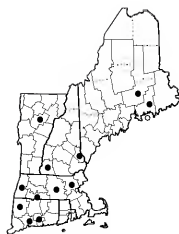
Figure 11. Distribution maps



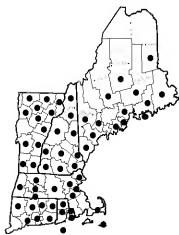
*MALUS BACCATA*



*MALUS FLORIBUNDA*



*MALUS PRUNIFOLIA*



*MALUS PUMILA*



*MALUS SIEBOLDII*



*MALUS X ADSTRINGENS*



*MALUS X ARNOLDIANA*



*MALUS X MAGDEBURGENSIS*



*MALUS X MICROMALUS*

Figure 12. Distribution maps

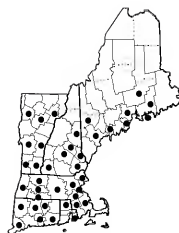




*MALUS X SOULARDII*



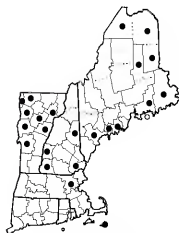
*PHOTINIA VILLOSA*



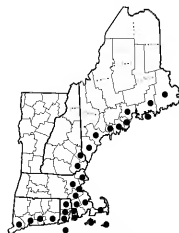
*PHYSOCARPUS OPULIFOLIUS*



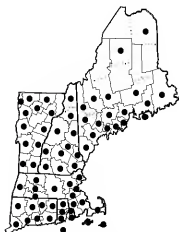
*POTENTILLA ANGLICA*



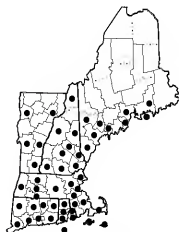
*Potentilla anserina*  
subsp. *anserina*



*Potentilla anserina*  
subsp. *pacifica*



*POTENTILLA ARGENTEA*

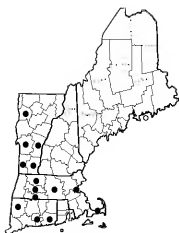


*Potentilla canadensis*

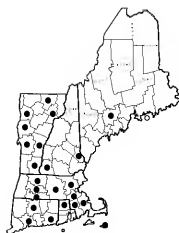


*POTENTILLA GRACILIS*  
var. *GRACILIS*

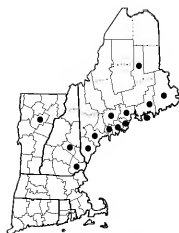
Figure 13 Distribution maps



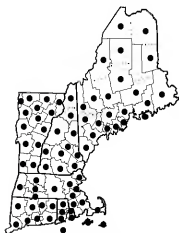
*POTENTILLA INCLINATA*



*POTENTILLA INTERMEDIA*



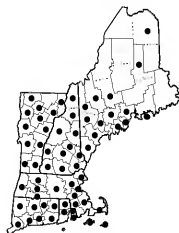
*Potentilla litoralis*



*Potentilla norvegica*



*POTENTILLA FULCHERRIMA*



*POTENTILLA RECTA*



*POTENTILLA REPTANS*

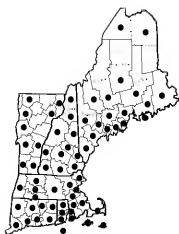


*POTENTILLA RIVALIS*



*Potentilla robbinsiana*

Figure 14. Distribution maps



*Potentilla simplex*



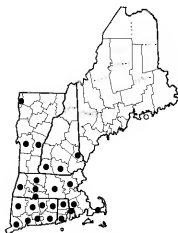
*POTENTILLA THURINGIACA*



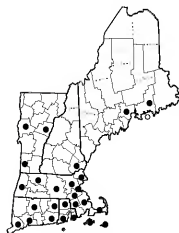
*POTENTILLA VERNA*



*POTERIDIUM ANNUUM*



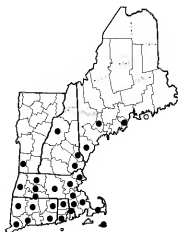
*Prunus americana*



*PRUNUS AVIUM*



*PRUNUS CERASIFERA*



*PRUNUS CERASUS*



*PRUNUS DOMESTICA*

Figure 15 Distribution maps



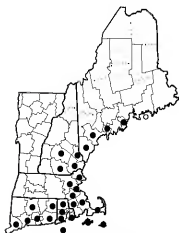
*PRUNUS HORTULANA*



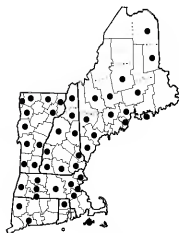
*PRUNUS INSITITIA*



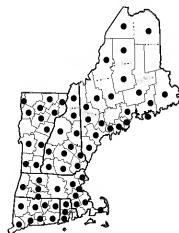
*PRUNUS MAHALEB*



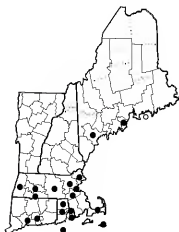
*Prunus maritima*



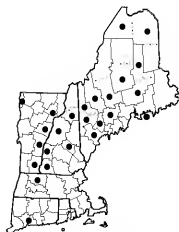
*Prunus nigra*



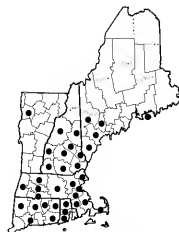
*Prunus pensylvanica*



*PRUNUS PERSICA*

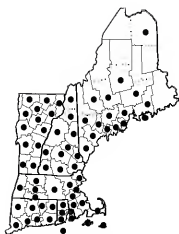


*Prunus pumila*  
var. *depressa*



*Prunus pumila*  
var. *susquehana*

Figure 16 Distribution maps



*Prunus serotina*  
var. *serotina*



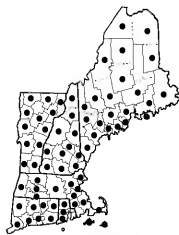
*PRUNUS SERRULATA*



*PRUNUS SPINOSA*



*Prunus umbellata*



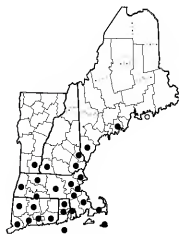
*Prunus virginiana*  
var. *virginiana*



*Prunus serotina* var. *serotina*  
X *P. virginiana* var. *virginiana*



*PYRUS CALLERYANA*

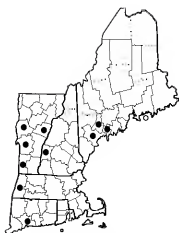


*PYRUS COMMUNIS*



*RHODOTYPUS SCANDENS*

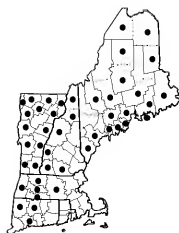
Figure 17. Distribution maps



*Rosa acicularis*  
subsp. *styri*



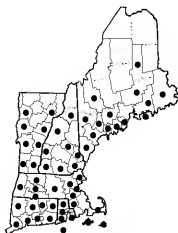
*ROSA ARKANSANA*



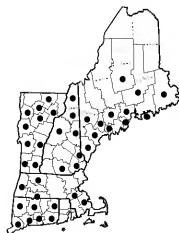
*Rosa blanda*



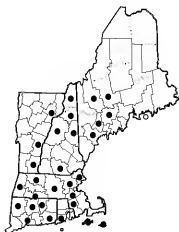
*ROSA CANINA*



*Rosa carolina*  
subsp. *carolina*



*ROSA CINNAMOMEA*



*ROSA GALLICA*



*ROSA GLAUCA*

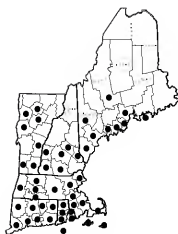


*ROSA LUCIAE*

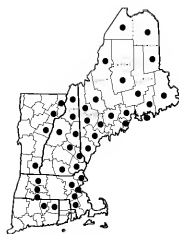
Figure 18. Distribution maps



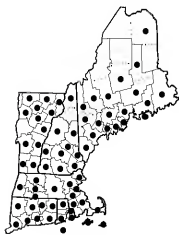
*ROSA MOLLIS*



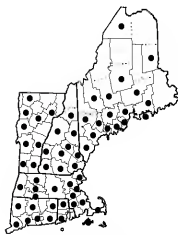
*ROSA MULTIFLORA*



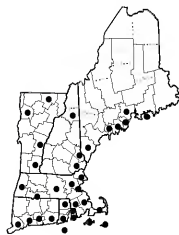
*Rosa rugosa*



*Rosa palustris*



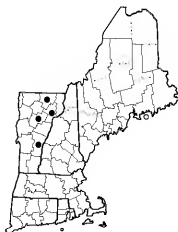
*ROSA RUBIGINOSA*  
var. *RUBIGINOSA*



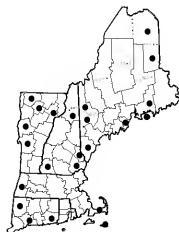
*ROSA RUGOSA*



*ROSA SETIGERA*

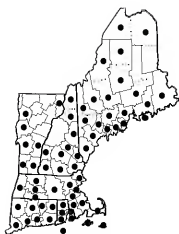


*ROSA SHERARDII*



*ROSA SPINOSISSIMA*

Figure 19 Distribution maps



*Rosa virginiana*



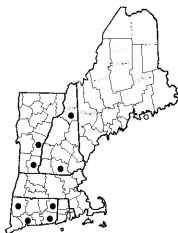
*Rosa carolina* subsp. *carolina*  
*X R. palustris*



*Rosa carolina* subsp. *carolina*  
*X R. RUBIGINOSA* var. *RUBIGINOSA*



*ROSA X CENTIFOLIA*



*ROSA X FRANCOFURTANA*



*Rosa nitida*  
*X R. palustris*



*Rosa nitida*  
*X R. virginiana*



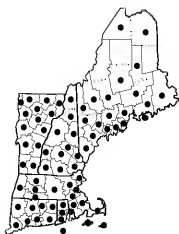
*Rosa X novae-angliae*



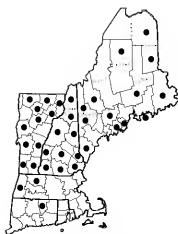
*Rosa palustris*  
*X R. virginiana*

Figure 20 Distribution maps

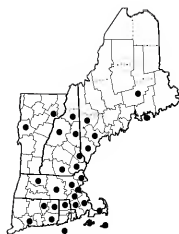




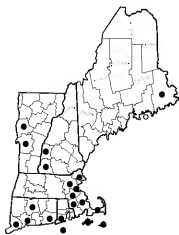
*Rubus alleghemensis*



*Rubus amcalis*



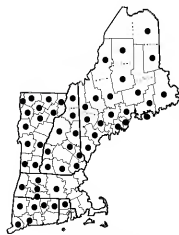
*Rubus aremicola*



*Rubus argutus*



*RUBUS BIFRONS*



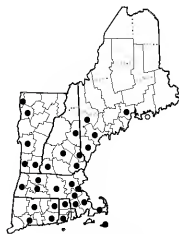
*Rubus canadensis*



*Rubus chamaemorus*

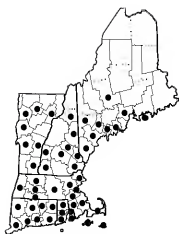


*Rubus cuneifolius*

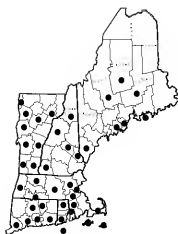


*Rubus enslemii*

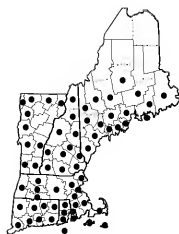
Figure 21. Distribution maps



*Rubus flagellans*



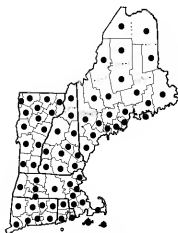
*Rubus frondosus*



*Rubus hispidus*



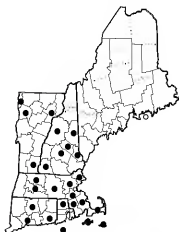
*RUBUS IDAEUS*  
subsp. *IDAEUS*



*Rubus idaeus*  
subsp. *strigosus*



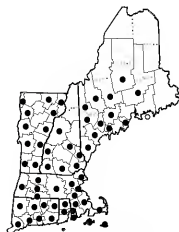
*RUBUS ILLECEBROSUS*



*Rubus joy-smithii*

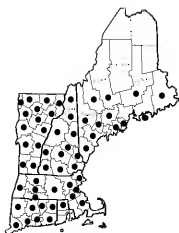


*RUBUS LACINIATUS*



*Rubus occidentalis*

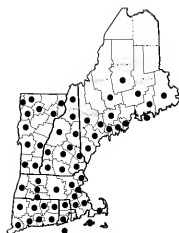
Figure 22. Distribution maps



*Rubus odoratus*



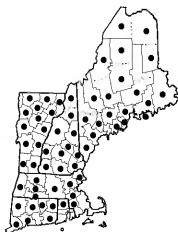
*RUBUS PARVIFOLIUS*



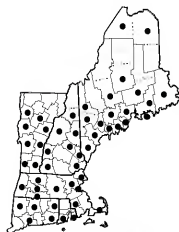
*Rubus pensilvanicus*



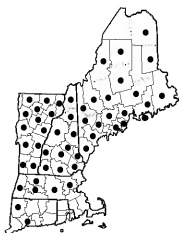
*RUBUS PHOENICOLASIUS*



*Rubus pubescens*



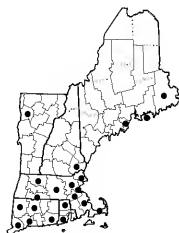
*Rubus recurvicaulis*



*Rubus repens*

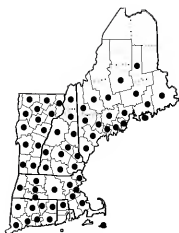


*RUBUS RORIBACCUS*

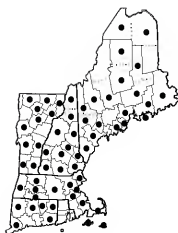


*Rubus semisetosus*

Figure 23 Distribution maps



*Rubus setosus*



*Rubus vermontanus*



*Rubus allegheniensis*  
*X R. amicalis*



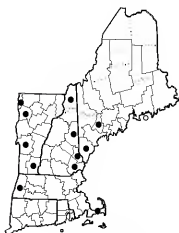
*Rubus allegheniensis*  
*X R. canadensis*



*Rubus allegheniensis*  
*X R. flagellaris*



*Rubus allegheniensis*  
*X R. frondosus*



*Rubus allegheniensis*  
*X R. hispidus*

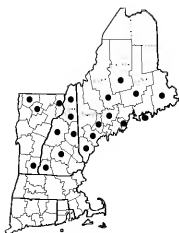


*Rubus allegheniensis*  
*X R. pensilvanicus*



*Rubus allegheniensis*  
*X R. recurvicaulis*

Figure 24. Distribution maps



*Rubus allegheniensis*  
X *R. setosus*



*Rubus allegheniensis*  
X *R. vermontanus*



*Rubus amicalis*  
X *R. frondosus*



*Rubus amicalis*  
X *R. jaysmithii*



*Rubus amicalis*  
X *R. recurvicaulis*



*Rubus amicalis*  
X *R. setosus*



*Rubus amicalis*  
X *R. vermontanus*

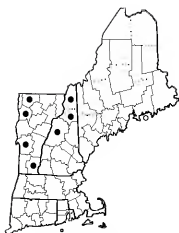


*Rubus canadensis*  
X *R. amicalis*



*Rubus canadensis*  
X *R. frondosus*

Figure 25 Distribution maps



*Rubus canadensis*  
*X R. pensilvanicus*



*Rubus canadensis*  
*X R. setosus*



*Rubus canadensis*  
*X R. vermontanus*



*Rubus enslemii*  
*X R. frondosus*



*Rubus enslemii*  
*X R. pensilvanicus*



*Rubus enslemii*  
*X R. recurvicaulis*



*Rubus flagellaris*  
*X R. frondosus*



*Rubus flagellaris*  
*X R. hispidus*



*Rubus flagellaris*  
*X R. recurvicaulis*

Figure 26 Distribution maps



*Rubus frondosus*  
*x R. hispidus*



*Rubus frondosus*  
*x R. jaysmithii*



*Rubus frondosus*  
*x R. recurvicaulis*



*Rubus frondosus*  
*x R. semisetosus*



*Rubus frondosus*  
*x R. setosus*



*Rubus frondosus*  
*x R. vermontanus*



*Rubus hispidus*  
*x R. jaysmithii*

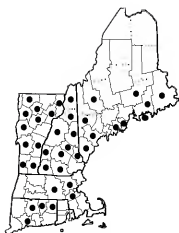


*Rubus hispidus*  
*x R. recurvicaulis*



*Rubus hispidus*  
*x R. semisetosus*

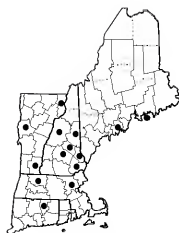
Figure 27. Distribution maps



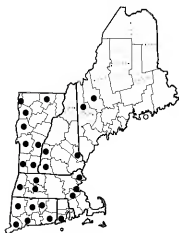
*Rubus hispida*  
*X R. setosus*



*Rubus hispida*  
*X R. setosus X R. vermontanus*



*Rubus hispida*  
*X R. vermontanus*



*Rubus X neglectus*



*Rubus pensilvanicus*  
*X R. recurvicaulis*



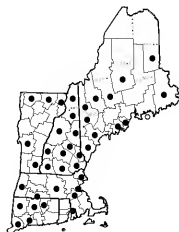
*Rubus recurvicaulis*  
*X R. setosus*



*Rubus recurvicaulis*  
*X R. vermontanus*



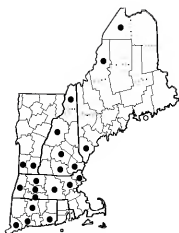
*Rubus semisetosus*  
*X R. setosus*



*Rubus setosus*  
*X R. vermontanus*

Figure 28. Distribution maps





*Sanguisorba canadensis*



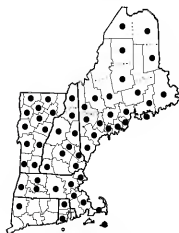
*SANGUISORBA MINOR*  
subsp. *MURICATA*



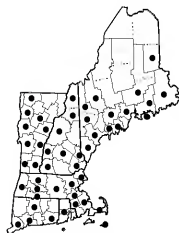
*SANGUISORBA OFFICINALIS*



*Sibbaldia procumbens*



*Sibbaldopsis tridentata*



*SORBARIA SORBIFOLIA*



*X. SORBARONIA FALLAX*



*X. SORBARONIA HYBRIDA*



*X. Sorbaronia jackii*

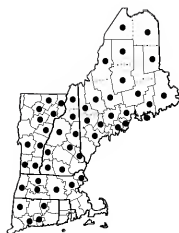
Figure 29 Distribution maps



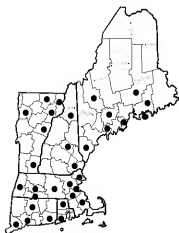
*X Sorbaronia monstrosa*



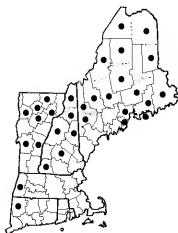
*X Sorbaronia sorbifolia*



*Sorbus americana*



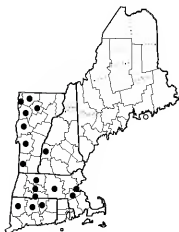
*SORBUS AUCUPARIA*



*Sorbus decora*



*SORBUS INTERMEDIA*



*Spiraea alba*



*SPIRAEA CHAMAEDRYFOLIA*

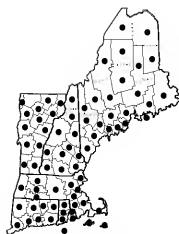


*SPIRAEA HYPERICIFOLIA*  
subsp. *OBOVATA*

Figure 30 Distribution maps



*SPIRAEA JAPONICA*  
var. *FORTUNEI*



*Spiraea latifolia*



*SPIRAEA NIPPONICA*



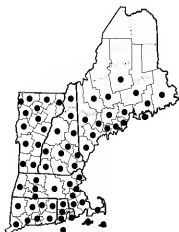
*SPIRAEA PRUNIFOLIA*



*Spiraea septentrionalis*



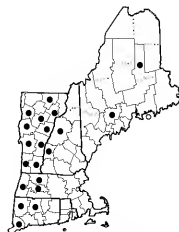
*SPIRAEA THUNBERGII*



*Spiraea tomentosa*



*SPIRAEA X VANHOUTTEI*



*Waldsteinia fragarioides*

Figure 31. Distribution maps

## GERANIUM PUSILLUM (GERANIACEAE): NEW TO TEXAS

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### ABSTRACT

*Geranium pusillum*, a native of Eurasia, is reported as adventive in the state of Texas. It is documented from Denton County, in the north central part of the state.

**KEY WORDS:** *Geranium*, Geraniaceae, Texas, USA

*Geranium* is a genus of about 350 species of worldwide distribution, with 137 species occurring in the New World. Aedo (2012) reports that 30 species occur in the USA, 16 introduced.

The genus is poorly represented in Texas. Correll and Johnston (1970) treated six species but one of these, *G. lentum* Wootton and Standley, has been determined to be based upon a misdetermination (Aedo 2012, p. 69). Turner et al. (2003) mapped five species as occurring in the state: *G. carolinianum* L., *G. texanum* (Trelease) A. Heller, *G. caespitosum* E. James, *G. seemannii* Peyritsch, and *G. dissectum* L. (which is cited as introduced). In his study of the genus in the New World, Aedo includes these same five species as occurring in Texas but treats *G. seemannii* as *G. seemannii* subsp. *seemannii*, conspecific with *G. seemannii* subsp. *repens* (H.E. Moore) Aedo of southern Mexico and Central America.

A sixth species is added here to the Texas flora, with documentation of its occurrence.

*Geranium pusillum* L. Texas. Denton Co.: 1.1 mi W of jct of Boss Range Rd. and Co. Rd. 407 on Co. Rd. 404, then N 6.0 mi from jct of Starder Ln. and Co. Rd. 407 on Starder Ln., 8 May 2012, J. Singhurst 19308 (BAYLU). Figure 1.

About 120 plants of *Geranium pusillum* were found in scattered bare spots among small patches of *Aegilops cylindrica* in clay-loam soils along a periodically maintained electrical transmission line right-of-way that bisects a high quality tallgrass prairie. Associated species included *Andropogon gerardii*, *Sorghastrum nutans*, *Salvia azurea*, *Delphinium virens*, *Liatris mucronata*, *Tridens muticus*, *Asclepias asperula*, *Carex microdonta*, *Sporobolus* sp., *Hymenopappus scabrosaeus*, *Camassia scilloides*, *Desmanthus illinoensis*, *Penstemon cobaea*, *Pediemelum* sp., *Echinacea atrorubens*, *Callirhoe thelesperma filifolium*, *Stenaria nigricans*, and *Dalea multiflora*.



Figure 1. *Geranium pusillum* L. (Singhurst 19308, BAYLU). Photo by Darrell Vodopich.

The following comments are largely based upon Aedo (2012), except as otherwise cited. *Geranium pusillum* is a native of Eurasia that has been introduced to Australia, North America, and South America (Argentina and Chile). In North America, the species is known from the northern two-thirds of the USA (Virginia–Tennessee west to California, north to southern Canada). It is an early introduction to the USA, being cited by Torrey (1826) in Pennsylvania. This persistence perhaps indicates that the species will become a permanent resident in the state. The distribution nearest to Texas is northwest Arkansas (Carroll and Madison counties) and northeast Oklahoma (Adair and Sequoyah counties).

*Geranium pusillum* is an annual characterized by having only five anther bearing stamens (Aedo 2012). All other species of *Geranium* known in Texas have ten stamens.

#### ACKNOWLEDGMENTS

We would like to acknowledge Mrs. Anne Smith for access to the Smith Ranch and the opportunity to study the ecology and flora of her tall grass prairie. We also are grateful to Darrell Vodopich, Department of Biology, Baylor University, for taking and processing the photograph of the *Geranium pusillum* specimen.

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# A NEW SPECIES OF *ACHYROPAPPUS* (ASTERACEAE: BAHIEAE) FROM QUERÉTARO, MEXICO

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## ABSTRACT

A novel species is removed from the fabric of *Achyropappus anthemoides* (H.B.K.) A. Gray and described as *Achyropappus queretarensis* B.L. Turner, **sp. nov.** With the new addition and recognition of the Guatemalan endemic, *A. depauperatus* (S.F. Blake) B.L. Turner, the genus now contains three species. A key to the species is provided, along with a photograph and line drawings of the novelty concerned; a map showing their distribution of the three species also is provided.

**KEY WORDS:** Asteraceae, Bahieae, *Achyropappus*, *Achyropappus anthemoides*, *Achyropappus depauperatus*, Mexico, Guatemala

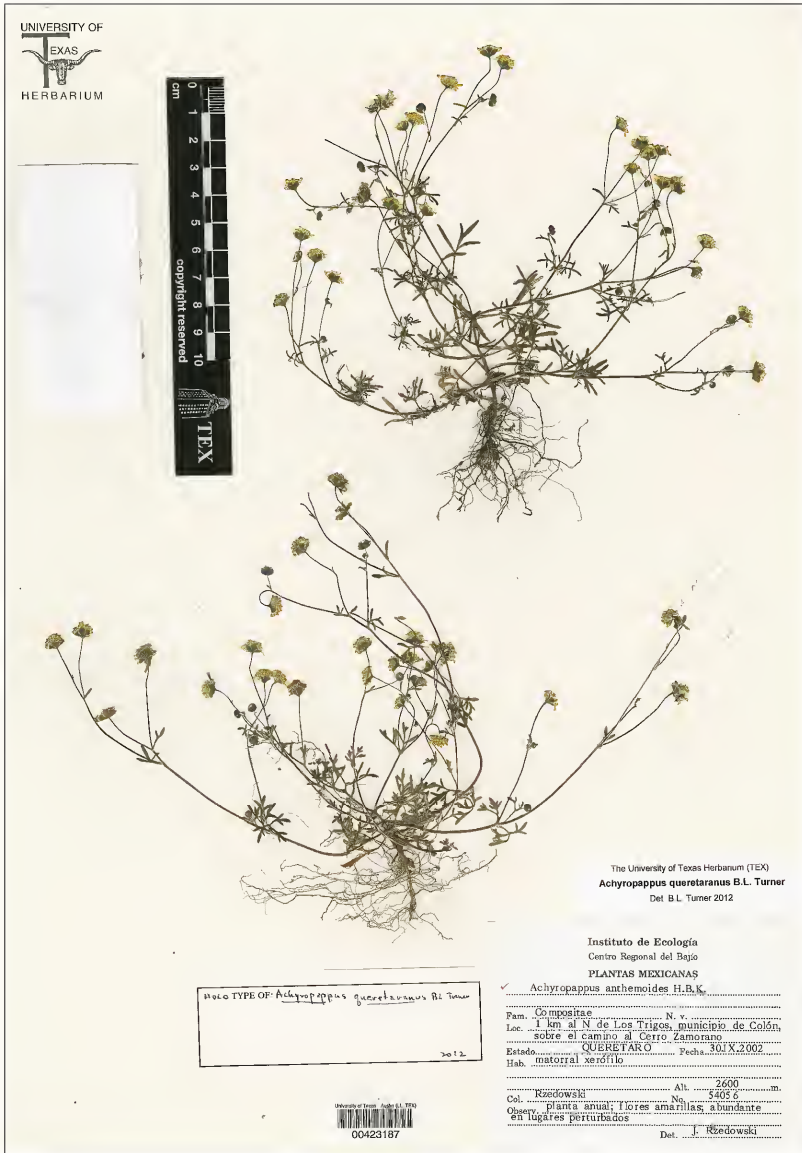
Preparation of an upcoming treatment of the tribe Bahieae of Mexico in my ongoing Comps of Mexico (cf. Turner 2012) has occasioned the present paper. The novelty described here in *Achyropappus*, along with previously known taxa, now provides three names for the genus, as follows:

1. Ligules of ray florets white, 4–8 mm long; plants mostly 20–80 cm high  
..... ***Achyropappus anthemoides***
1. Ligules of ray florets yellow, 1–3 mm long; plants mostly 6–20 cm high.  
..... ***Achyropappus depauperatus***
2. Involucral bracts ca. 3 mm long, widest near apex; pappus scales ca. 0.2 mm long; Guatemala  
..... ***Achyropappus depauperatus***
2. Involucral bracts ca. 4 mm long, widest near middle; pappus scales 1–2 mm long; Mexico  
..... ***Achyropappus queretarensis***

**ACHYROPAPPUS QUERETARENSIS** B.L. Turner, **sp. nov.** Figure 1 **TYPE:** MEXICO. Querétaro. Mpio. de Colón: sobre el camino al Cerro Zamorano, matorral xerófilo, abundante in lugares perturbados, 2600 m, 30 Sep 2002, *J. Rzedowski 54056* (holotype: TEX)

Resembling *A. anthemoides* H.B.K. but a smaller, more delicate plant having smaller leaves (1–2 cm long vs 2–4 cm), ray florets yellow and 3 to a head (vs white and mostly 4–5 to a head), and stems and foliage sparsely glandular pubescent (vs densely so).

**Annual herbs** 5–18 cm high. **Mid-stems** much-branched below, sparsely pubescent with both glandular and/or eglandular hairs. **Leaves** (mid-stem) tripartite, mostly 1–2 cm long, the lowermost opposite, the upper alternate; petioles winged, 2–10 mm long, ciliate with spreading eglandular hairs. **Capitulescence** a terminal array of 1–5 heads forming a loose panicle 2–6 cm across, the ultimate peduncles 1–5 cm long. **Heads** ca 10 mm wide (rays excluded), 4–5 mm high; outer involucral bracts 5, ca 4 mm long, 3 mm wide, broadest near the middle, the margins scarios. **Receptacle** epaleate, plane, ca 1.2 mm across. **Ray florets** 3, pistillate, fertile; ligules yellow, 2–3 mm long. **Disc florets** yellow, 20–30 per head; corollas 5-lobed, ca 2 mm long, the throat ca 0.5 mm

Figure 1. *Achyropappus quereharensis* (holotype, TEX).



long. **Achenes** black, smooth, 3–4-sided, 2–3 mm long, the outer series to some extent pubescent with villous hairs, the inner series mostly glabrous; pappus of ca 8 ribless scales, 1.0–2.0 mm long.

Additional specimens examined: MEXICO. **Guanajuato.** Mpio. De San Luis de la Paz: 9 km al NE de Chupaderos, sobre el camino a Mesas de Jesus, 2250 m, 8/11/92, *Rzedowski 51869* (TEX). **Hidalgo.** Mpio Zimapan: on felsitic ledges in open thorn scrub area at Puerto de la Estancia ca 53 km NW of Ixmiquilpan, ca 2000 m, 21 Oct 1974, *Cronquist 11267* (LL).

The species name derives from the state of Querétaro, whence the type.

When originally discerned I considered the idea of describing the novelty as but a variety of *A. anthemoides*, but their allopatric distribution and lack of intermediates swayed my thinking to that expressed here.

**ACHYROPAPPUS ANTHEMOIDES** H.B.K., Nov. Gen. & Sp. (folio ed.) 4: 203, pl. 390. 1820[1818]. *Schkuhria anthemoides* (Kunth) Wedd., Chlor. Andina 1: 74. 1855[1856]. *Bahia anthemoides* (H.B.K.) A. Gray, Proc. Amer. Acad. Arts 15: 40. 1879. TYPE: MEXICO. Edo. Mexico. "Crescit in agro frigido Toluensi, prope pagum Islahuaca, alt. 1380 hex.," Sep, *Humboldt & Bonpland s.n.* (holotype: P).

The type of this species was described from near Toluca in considerable detail by H.B.K. and illustrated by a full page plate. A detailed description (including the present *Achyropappus queretaramis*) and full page illustration (presumably of *A. anthemoides*, sensu the present author) was provided by Villarreal et al (2006). Chromosome number,  $2n = 20$ . Figure 2.

Hidalgo, Tlaxcala, and Edo. Mexico; oak-juniper woodlands, 2600–3000 m; Aug–Sep.

*Achyropappus anthemoides* reportedly grows at somewhat higher elevations than *A. queretaramis* (2600–3000 m vs. 2200–2600 m). The species superficially resembles *Villanova achillaeoides* (tribe Perityleae, sensu Panero 2007) but is readily distinguished by its larger rays and pappose achenes.

**ACHYROPAPPUS DEPAUPERATUS** (S.F. Blake) B.L. Turner, Phytologia 92: 349. 2010. *Bahia depauperata* S.F. Blake, Brittonia 2: 352. 1937. TYPE: GUATEMALA. Dept. Huehuetenango. Heavily grazed alpine pasture, S side of the Sierra Cuchumatanes, along trail between Huehuetenango and Soloma, 3200 m, 16 Sep 1934, *A. Skutch 1271* (holotype: GH!). Figure 2.

Known to me only by the type.

Blake, in his original, very detailed description, reckoned the present taxon to be better positioned in the genus *Bahia*, comparing it to *B. anthemoides* (= *Achyropappus anthemoides*) but Baldwin et al. (2002), using DNA data, retained both genera. Strangely, Nash and Williams (1976), in their account of Asteraceae for the Flora of Guatemala, failed to account for the taxon concerned.

In short, *Bahia depauperata* seems best positioned in the genus *Achyropappus*, along with its presumed closest relative, *A. anthemoides* (if not *A. depauperatus*), an affinity suggested by the characters given in the above key.

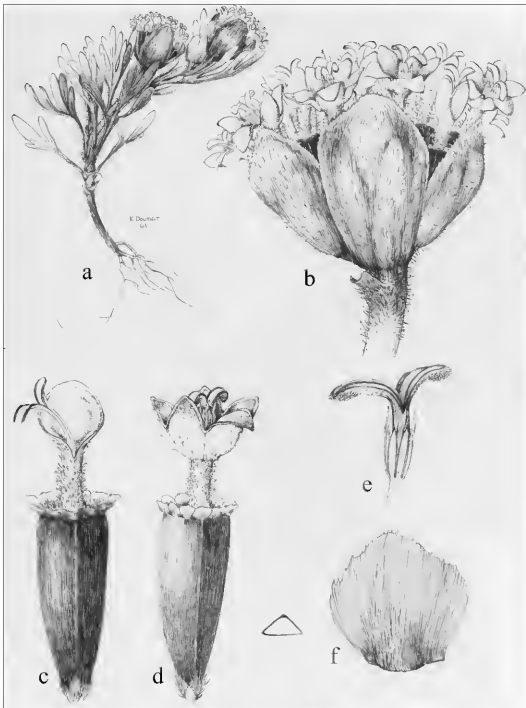


Figure 2. Sketches of *A. depauperatus* (from holotype, GH): (a) habit [6 cm high], (b) head [4 mm high], (c) ray floret [3.5 mm high], (d) disc floret [3.5 mm high], (e) stamens and style branches [0.03 mm long], (f) pappus scale [0.02 mm long]. Produced by the well-known illustrator, K. Douthett of the University of Michigan, from NSF funds provided to the author many years ago now.

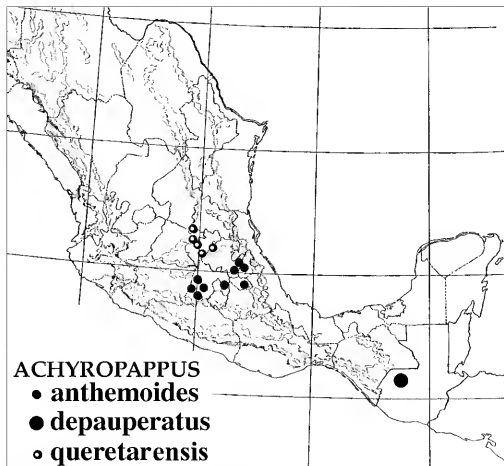


Figure 3. Distribution of *Achyropappus* species.

#### ACKNOWLEDGEMENTS

My research companion, Jana Kos, edited the paper, providing constructive input. Thanks to Dr. José Panero for his comments in review and to GH for the loan of appropriate material.

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***POLYTAENIA ALBIFLORA* (APIACEAE),  
A NEW SPECIES FROM THE BALCONES CANYONLANDS  
IN THE EDWARDS PLATEAU OF TEXAS**

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**ABSTRACT**

A new species of *Polytaenia* is described from the Balcones Canyonlands Subregion of the Edwards Plateau of Texas. *Polytaenia albiflora* E.L. Keith, sp. nov., is described, illustrated, and distinguished from *Polytaenia muttallii* and *Polytaenia texana*. The combined characteristics of white flowers, lack or reduction of involucre bracts, larger schizocarps, and unique habitat distinguish this species from the other two species of *Polytaenia*. The apparent rarity of *P. albiflora* warrants its consideration as a candidate for state and federal regulatory protection. Included is a species key and distribution map for the genus in Texas.

**KEY WORDS:** Apiaceae, Apioideae, *Polytaenia albiflora*, *Polytaenia muttallii*, *Polytaenia texana*, Balcones Canyonlands

In April 2012, an unusual population of *Polytaenia* DC. was discovered near the base of a mature forested bluff approximately 30 meters from the Frio River on a recent land acquisition in Garner State Park (McKorkle 2010). This discovery was made while conducting vegetation and fuel model assessments for the park as part of a multi-year research project to acquire baseline data and conduct long-term monitoring of the natural vegetation communities in all of the state parks in Texas (TPWD 2010).

With an extensive search, only fifteen plants (ten in flower) were observed in the Garner State Park location. Only one plant (the type) was collected in April because of the small population size. Nearly mature fruit and fully mature fruit from two adjacent plants were subsequently collected by Mike Lloyd, Texas Parks and Wildlife Department (TPWD) State Parks Wildland Fire Management Specialist, at two different times in May and June 2012.

The plants appeared distinctive because of the white flowers and unique habitat in the shade of a mature forest canopy. After examination of numerous herbarium specimens of potentially close relatives and literature study of Apiaceae, the plant aspect, leaf structure, floral structure, and schizocarp morphology revealed that this novelty represented a new species in *Polytaenia* (Correll & Johnston 1970; Coulter & Rose 1900, 1909; Diggs et al. 1999; Hatch et al. 1990; Jones et al. 1997; Kartesz 2012; Menglan et al. 2005; Michigan Flora Online 2011; Nesom 2012; St. John 1919; Turner et al. 2003; USDA 2012; and Tutin et al. 2010).

**POLYTAENIA ALBIFLORA** E.L. Keith, sp. nov. (Figs. 1 and 2) **TYPE:** USA. Texas. Uvalde Co.: Wooded slope at base of Old Baldy, ca. 30 meters S of Frio River just above normal flood zone; associates *Celtis reticulata*, *Tilia caroliniana*, *Juniperus ashei*, *Fraxinus texensis*, *Ungnadia speciosa*, *Aesculus pavia* var. *flavescens*, *Sophora affinis*, *Timantia anomala*, *Carex edwardensis*, *Dichanthelium pedicellatum*, *Parietaria pennsylvanica*, *Viguiera dentata*, and *Salvia roemeriana*; UTM NAD 83: 3272091.776 E, 429492.465 N; 19 Apr 2012, Eric L. Keith 1028 (holotype: TEX).

*Polytaenia albiflora* is similar to *P. texana* (Coult. & Rose) Mathias & Constance in overall aspect, leaf arrangement, similar floral structure, dorsally flattened schizocarp with lateral ribs corky thickened into wings, four distinct and raised oil tubes on the dorsal surface of the mericarp, and two distinct and raised oil tubes on the commissural face. It differs in its white flowers, shorter stature, usually larger schizocarps, less dissected leaves, generally wider cauline leaflets, and reduced lanceolate involucre bracts or bracts often absent.

**Perennial herbs**, without odor, moderately to densely scabrous in the inflorescence with minute, conic, papillate hairs, otherwise glabrous; taproot apparently thickened. **Stems** 6–8 dm. **Leaves**: basal 1–2-pinnately compound, cauline 1-pinnately compound, blades oblong to ovate in outline, 8–17 cm x 8–12 cm, herbaceous and slightly thickened; leaflets 3–5, pinnately to subpinnately divided, lobes ovate or oblanceolate to narrowly oblong, 2–3 cm x 1–2 cm, cauline leaves smaller than basal leaves; bases rounded to cuneate, sessile to petiolulate, margins coarsely serrate; petioles with dilated and densely hispid, scabrous sheaths. **Inflorescence**: peduncles terminal and axillary, 1–6 cm; rays 1–2 cm, subequal to unequal. **Umbels** compound; umbellets 6–15; involucre bracts absent, involucre bracts often absent, but occasionally with 1 to 3 lanceolate bractlets to 3 mm long with slightly keeled, green to yellowish-green dorsal stripes and white hyaline margins. **Pedicels** 1–4 mm. **Flowers** protogynous; sepals lanceolate-subulate, persistent; petals white, apices extended into an appendage half as long as the petal and folded under and often adnate to the abaxial surface, deciduous; stylopodium absent. **Schizocarps** oval to slightly obovate, strongly flattened dorsally, (9–)11–15 mm x (6–)7–9.5 mm, splitting into 2 mericarps, narrowly to broadly corky-winged, dorsal ribs distinct, 3, thin, orange or tan; lateral ribs developing into wings that are relatively thin and same thickness as the face; oil tubes of dorsal face 4, raised and distinct; oil tubes of commissural face 2, slightly raised and less distinct than dorsal oil tubes, one on each side of the midrib, surface smooth, glabrous; carpophore bifid.

Additional collections examined: **USA. Texas. Bandera Co.**: Rock crevice, roots fleshy and brittle, head of Sabinal Canyon, 21 Jun 1946, *Correll & Correll 12828* (BRIT); Hill Country State Natural Area: Southeast area of park, near Chapa's group camp site, banks of West Verde Creek, 16 Apr 1994, *Lackey 457* (BRIT). **Comal Co.**: Honey Creek Preserve, ca. 100 m S of the confluence of the Guadalupe River and Honey Creek, limestone cliff above creek with *Diospyros texana* and *Forestiera*, rare perennial to 1 m, corolla white, 17 May 1984, *Poole 2555* (TEX). **Gillespie Co.**: Enchanted Rock, [no date], *Jerry s.n.* (BRIT). **Kendall Co.**: In moderately dry shady soil below Edge Falls, 3 May 1947, *Tharp, Webster, & Barkley 177158* (TEX); 8 3/4 mi NW of Boerne, 24 May 1935, *Parks & Cory 14013* (BRIT, TEX, TAES); **Uvalde Co.**: Wooded slope at base of Old Baldy ca. 30 meters S of Frio River just above normal flood zone, [immature schizocarps and inflorescence], 18 May 2012, *Lloyd s.n.* (TEX); [mature schizocarps], 21 Jun 2012, *Lloyd s.n.* (TEX).

**Etymology.** The epithet refers to the white flowers, a unique feature of the genus. The other two species have yellow flowers.

**Distribution and habitat.** *Polytaenia albiflora* is currently known from the Balcones Canyonlands Subregion of the Edwards Plateau Natural Region in Texas (Diamond et al. 1987) (Figs. 3 & 4). The Gillespie Co. collection is from an unspecified location (Enchanted Rock) and date; therefore, it may represent a labeling error (Figures 3 and 4). If the collection was actually made at Enchanted Rock, then the species may be found in similar habitats in the Llano Uplift Subregion (Diamond et al. 1987). This species is apparently another of the approximately 36 endemic species restricted to the Edwards Plateau, including several that have been discovered recently. Recent discoveries include *Cardamine carrii* B.L. Turner, *Prenanthes carrii* Singhurst, O'Kennon, and W.C. Holmes, *Phaseolus texensis* A. Delgado & W.R. Carr, and *Galactia watsoniana* W.C. Holmes & Singhurst (Delgado-Salinas & Carr 2007; Diamond et al. 1987; Holmes & Singhurst 2008; Poole et

al. 2007; Turner et al. 2003; Turner 2012). This new species does occur with several endemic species and in close proximity to (but not with) *Cardamine carrii* in Garner State Park (Turner et al. 2003; personal observation).

At the type locality, the following species were closely associated with *Polytaenia albiflora*: *Celtis reticulata* Torr., *Tilia caroliniana* Mill., *Juniperus ashei* J. Buchholz, *Fraxinus albicans* Buckley, *Ungnadia speciosa* Endl., *Aesculus pavia* var. *flavescens* (Sarg.) Correll, *Sophora affinis* Torr. & A. Gray, *Tinantia anomala* (Torr.) C.B. Clarke, *Carex edwardsiana* Bridges & Orzell, *Dichanthelium pedicellatum* (Vasey) Gould, *Parietaria pennsylvanica* Muhl. ex Willd., *Viguiera dentata* (Cav.) Spreng., and *Salvia roemeriana* Scheele.



Figure 1. *Polytaenia albiflora*. Clockwise from top left: Habit. Inflorescence. Mature schizocarps (photo by Mike Lloyd). Immature schizocarps.



Figure 2. Comparison of lateral views of *Polytaenium texense* (top: A dorsal face and B ventral face) and *P. allylora* (bottom: C dorsal face and D ventral face)

**Relative ecology.** The closest relatives of *Polytaenium* in subfamily Agrostodeae are species in the genera *Thysanotus* and *Zoae* according to combined morphological and molecular analyses (Sosa & Duvall 2010). *Polytaenium* differs from these two genera by possessing narrow filiform or lanceolate unicolored leafllets (in some in *P. allylora*), dorsally compressed or lanceolate with lateral ribs only thickened into wings, and by dorsal and lateral ribs narrow and discrete (Coulter & Rose 1909; Michigan Flora Online 2011).

*Polytaenium allylora* appears to be most closely similar to *P. texense* by its similar morphology and occasionally similar habitats, especially in the western portion of the range of *P. texense*. The two species are sympatric but are clearly separated by ecological preferences. *Polytaenium allylora* appears to be restricted to mature forested slopes in shade and *Polytaenium texense* occurs most commonly in open areas such as grasses, old fields, roadsides, sandy alluvium along rivers and openings in woodlands and oak juniper slopes (Hewitt 2012, personal observation). The nearest known population of *P. texense* to the Chisos State Park population is approximately 35 kilometers north-northeast in edge of Real County (Hewitt 2012; Plant Resources Center 2012).

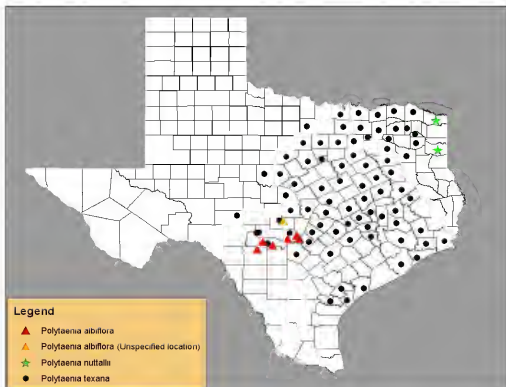


Figure 3. County distribution of *Polytaenia albiflora*, *P. texana*, and *P. nuttallii* in Texas, based on map in Nesom (2012) and collections from SHST, SMU-BRIT-VDB, TAES, TAMU, and TEX-LL.

A key to all three species of *Polytaenia* is derived from Nesom (2012) and personal observations.

1. Flowers white, plants to 8 dm in height, involucre absent or of 1–3 reduced lanceolate bractlets to 3 mm long, fruit (9–)11–15 mm x (6–)7–9.5 mm, forested rocky slopes, endemic to Edwards Plateau of Texas ***Polytaenia albiflora***
1. Flowers yellow, plants to 15 dm in height, involucre of linear or filiform bractlets usually > 4 mm long, fruit 5–11(–15) x 4–7 mm, mostly open habitats, widely distributed in Texas, north to Kentucky, Michigan, and Iowa.
  2. Fruit 5–11 mm x 4–7 mm, lateral wings narrower and thicker than the body, oil ducts indistinct, several in the intervals, in sandy soil in the Timber Belt and the Blackland Prairies from Texas and Louisiana, north to Kentucky, Michigan, and Iowa ***Polytaenia nuttallii***
  2. Fruit 9–11(–15) x 6–7 mm, lateral wings broader and thinner than the body, oil ducts distinct, solitary in the intervals, abundant on the Blackland and Coastal prairies and the Edwards Plateau, endemic to Texas and southern Oklahoma ***Polytaenia texana***



As currently understood, *Polytaenia albiflora* is endemic to the Balcones Canyonlands Subregion (or possibly including Llano Uplift Subregion) of the Edwards Plateau in Texas and is fairly uncommon (Diamond et al. 1987) (Fig. 4). Fortunately, at least two populations of *P. albiflora* are relatively protected in Garner State Park and Honey Creek State Natural Area. However, since this species appears to have a restricted distribution, it should be considered as a candidate for federal and state protected species status. Additional populations should be sought in similar habitats throughout the Edwards Plateau.

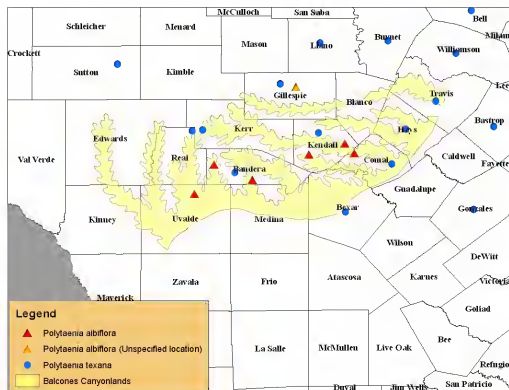


Figure 4. County distribution of *Polytaenia albiflora* and *P. texana* in Balcones Canyonlands Subregion and surrounding area, based on map in Nesom (2012) and collections from SHST, SMU-BRIT-VDB, TAES, TAMU, and TEX-LL.

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## VILLARREALIA (APIACEAE), A NEW GENUS FROM NORTHERN MEXICO

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### ABSTRACT

*Villarrealia* Nesom, gen. nov., is described primarily to include *Villarrealia* (*Aletes*) *calvicola* (Mathias & Constance) Nesom, comb. nov., of Coahuila and western Nuevo León, Mexico. Its close relatives have been indicated by molecular data to be the essentially eastern USA genera *Polytaenia*, *Thaspium*, and *Zizia*, and a set of floral features provides a synapomorphy for the group of four genera. Illustrations and distribution maps are provided for both species.

**KEY WORDS:** *Villarrealia*, *Polytaenia*, *Thaspium*, *Zizia*, Coahuila, Nuevo León, Mexico

Recent molecular-morphological study of endemic western North American Apiaceae subfamily Apioideae (Downie et al. 2002; Sun et al. 2004; Sun & Downie 2010) opens perspectives toward understanding relationships among those genera and species. Morphological study of the group by R.L. Hartman and G.L. Nesom (in prep., in connection with taxonomic treatments for the developing Flora of North America) brings additional insights.

In particular for the present study, a strongly supported monophyletic subgroup (fide Sun & Downie 2010) within the American Apioideae comprises the mostly eastern and central North American genera *Polytaenia* DC. (Keith 2012; Nesom 2012), *Thaspium* Nutt., and *Zizia* Koch (e.g., Cooperrider 1985; Lindsey & Bell 1985) as well as the single species *Aletes calvicola* Mathias & Constance of north-central Mexico. The "*Thaspium* group" arises from within Clade 3 (see Fig. 2 of Sun and Downie, a strict consensus tree based on molecular and morphological characters), which is strongly supported by molecular data, less so morphologically. Cladistic relationships within the group are this: (*Aletes calvicola* (*Polytaenia* (*Thaspium*, *Zizia*))).

The *Thaspium* group, however, in the Sun & Downie analysis, is defined by a non-homoplasious synapomorphy — erect and only slightly divergent style branches — as well as a homoplasious one — distally hirtellous rays. The present study adds another apparently non-homoplasious synapomorphy (within American Apioideae) for the *Thaspium* group — the distal half of each petal is permanently sharply folded down to the inside (induplicate) (see Fig. 2c; Bell 1971; Lindsey & Bell 1985). In *Polytaenia*, the induplicate portion is like a narrowed appendage and is adnate near its apex to the erect proximal portion; in *Thaspium* and *Zizia*, the induplicate portion is free. In other genera, the petals may be rolled inward, but they are not sharply bent.

As in the other species of the group, *Aletes calvicola* has erect style branches and hirtellous rays and the petals are permanently induplicate. It differs from the other species in having 3 oil tubes per dorsal interval (vs. 1 per interval in *Polytaenia*, *Thaspium*, and *Zizia*) as well as an accessory oil tube at the apex of each rib. *Thaspium* and *Zizia* are distinct within the endemic Apioideae in their fascicled roots and they also share (as homoplasious) entirely scarious involucre bractlets. *Polytaenia* is distinct in its much taller, caulescent habit and larger leaves. All of the species, including *A. calvicola*, have non-winged fruits.

In the original description of *Aletes calvicola*, the authors noted that they had previously "attempted to refer it the genera *Aletes*, *Musenion*, *Ligusticum*, and *Tauschia*" before settling on

*Aletes*, where it still did not fit unambiguously. Subsequent to the publication of a study of *Aletes* (Theobald et al. 1963), the addition of the caulescent (though inconsistently) *Aletes filifolius* Mathias, Constance, & W.L. Theob. to *Aletes* (Mathias et al. 1969) made it possible to consider *A. calcicola*, which is similar in habit to *A. filifolius*. Like most other *Aletes* and *Cymopterus*, however, *A. filifolius* has winged fruits.

Weber (1984) broadened the concept of *Aletes*, apparently accepting the species of Theobald et al. (1963) and adding 14 more, including *Neoparrya*. He did not mention either *A. calcicola* or *A. filifolius* but both apparently could have been included in his *Aletes* circumscription, judging from his account of a constellation of diagnostic morphological characters, especially including these: pseudoscape lacking; plants strongly scented; flowers yellow, white, or purple; mericarps trapezoidal (x.s.), not or variably dorsally compressed; oil tube variable in number, size, and disposition; and lack of stylopodium. Weber's recognition of a densely caespitose, strictly acaulescent habit as diagnostic presumably would have weighed against his acceptance of *A. calcicola*.

Cronquist (1997) suggested informally that *Aletes* and *Musneon* might be considered congeneric, further broadening the concept of the potentially resultant genus—*Musneon divaricatum* (Pursh) Nutt. (the type of *Musneon*) is caulescent and commonly produces a pseudoscape, and *Musneon* species have non-winged fruits. The molecular study by Sun and Downie (2010) indicates that a weakly supported monophyletic group is indeed formed by *Aletes* (fairly close to the concept of Theobald et al.), though it also includes *Pseudocymopterus* and other species. The species of *Musneon* are not phylogenetically coherent and the broader group does not include those species added by Weber. Nor, as implied above, does this "*Aletes* group" include *A. calcicola*.

In view of its molecular and morphological distinction, *Aletes calcicola* is recognized here as a distinct genus. The new genus is named for José A. Villarreal-Quintanilla of the Universidad Autónoma Agraria Antonio Narro in Saltillo, Mexico—an excellent botanist in the field and herbarium and in documentation of his studies through publications.

**VILLARREALIA** G.L. Nesom, **gen. nov.** TYPE: *Villarrealia calcicola* (Mathias & Constance) Nesom

Similar to *Polytaenia*, *Thaspium*, and *Zizia* in its staminate and bisexual flowers within an umbellet, lack of a stylopodium, style branches filiform, flexuous and erect to ascending-erect, dorsally compressed (slightly) and non-winged schizocarps, and permanently sharply induplicate petal apices. Distinct in its combination of taprooted habit and 3 oil tubes per dorsal interval as well as an accessory oil tube at the apex of each rib.

**VILLARREALIA CALCICOLA** (Mathias & Constance) Nesom, **comb. nov.** *Aletes calcicola* Mathias & Constance, *Brittonia* 33: 342, fig. 1. 1981. TYPE: MEXICO, Coahuila, Sierra de la Gloria, SE of Monclova, steep, gravelly limestone slopes in pine-oak woodland and chaparral, 1250–3000 m, Jul 1939, E.G. Marsh 1895 (holotype: GH, photo-UC; isotype: TEX!).

Plants perennial from a thick taproot, caespitose from a branching root crown bearing old leaf sheaths, acaulescent or with 1–2 cauline leaves on a short stem (e.g., Fig. 1); stems and leaves slightly scaberulous; "whole plant with flavor and smell of celery" (Johnston et al. 10305A) or "odor like chuchupastle mixed with celery" (Johnston et al. 12059A). Stems (0)–1–4 dm, erect. Leaves: blades ovate to ovate-lanceolate in outline, 3–12 cm x 3–15 cm, ternately pinnately compound; leaflets ovate to lanceolate, 5–40 mm x 2–40 mm, usually pinnately lobed to pinnatifid with oblong to lanceolate, mucronulate ultimate divisions, scaberulous on veins beneath; petioles 3–15 cm long, scarious-sheathing at base. Peduncles 6–15 cm, longer than leaves, scaberulous at base of umbel. Involucre bracts absent. Rays 4–7, 1.5–3 cm, unequal, spreading ascending, scaberulous. Involucel

**bractlets** 2–8, linear-lanceolate, 1.5–3 mm, sometimes with very narrow scarious margins proximally, distinct to slightly connate at base. **Umbellets** 10–20-flowered, pistillate flowers 2–6; pedicels 3–5 mm, unequal. **Sepals** triangular-ovate. **Petals** narrowly ovate, apices extended into an appendage half as long as the petal and folded under and adnate near the apex to the abaxial surface, yellowish to light yellow-cream or greenish-white. **Styles** ca 2 mm, filiform, flexuous and essentially erect. **Stylopodium** absent. **Carpophore** divided in distal 1/3. **Schizocarps** oblong to oblong-oval, 5–6 mm, ribs subequally prominent and corky but unwinged; mericarps with oil tubes mostly 3 per dorsal interval, 1 at the apex of each rib, 2 on the commissure. **Seeds** subterete in transection, face plane.



Figure 1. Representative collection of *Villarrealia calcicola*. Note variation in habit, caulescent (left) and acaulescent (right).

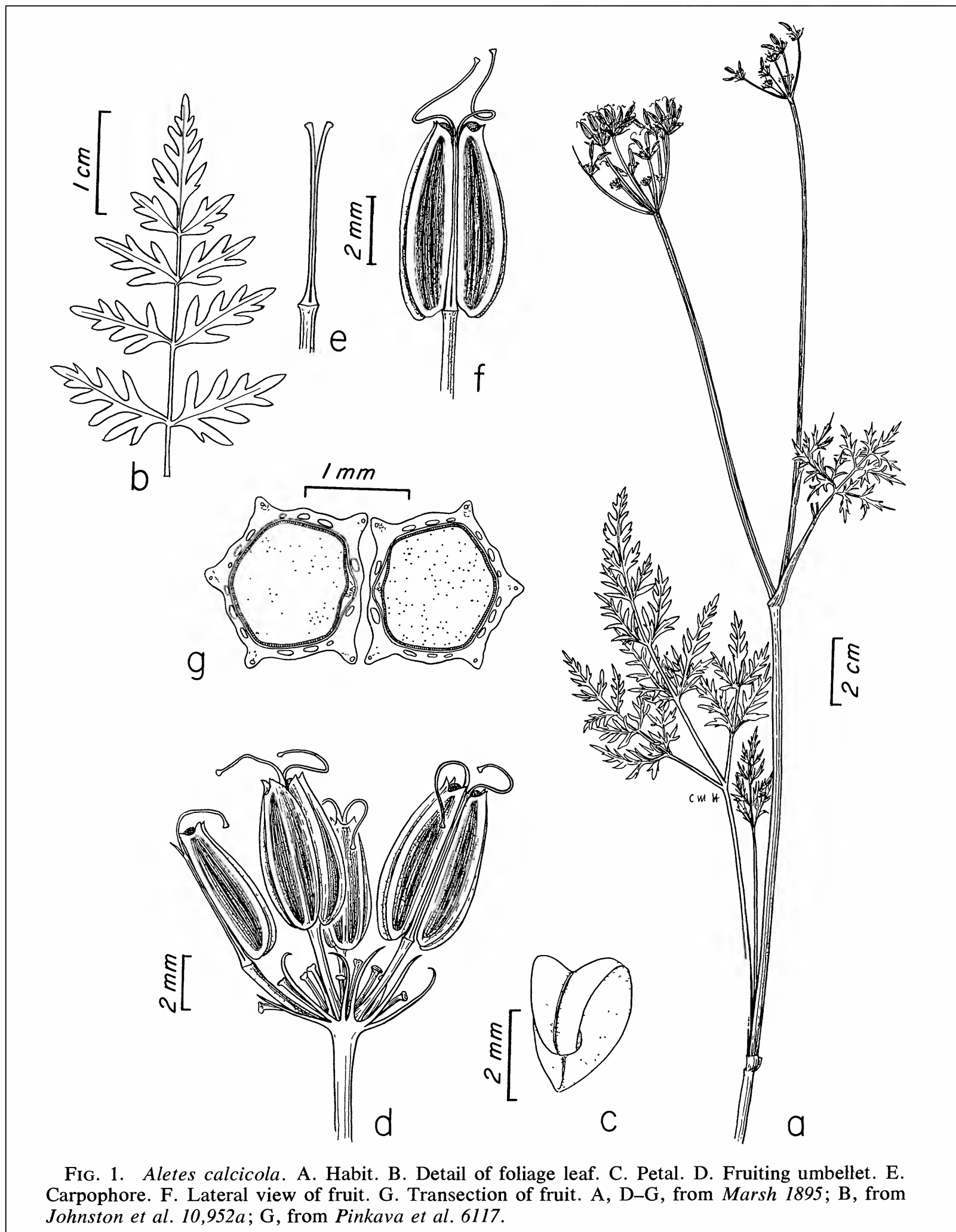


Figure 2. *Villarrealia calcicola*. Reproduced from Mathias and Constance (1981) with permission of the publisher. © The New York Botanical Garden Press, Bronx.

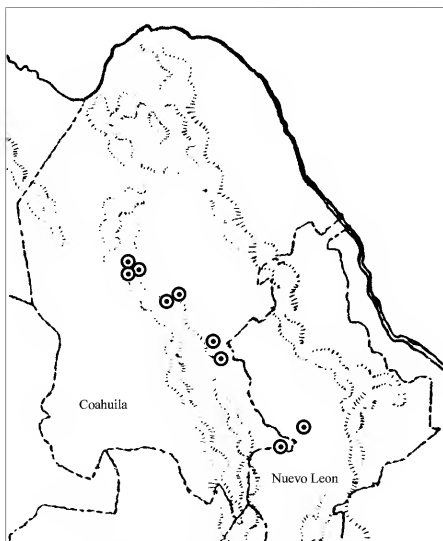


Figure 3. Distribution of *Villarrealia calcicola*.

Additional collections. **MEXICO. Coahuila.** Ca. 30 km WNW of Cuatro Ciénegas on the N side of Sierra de la Madera, at the mouth of Cañon Desiderio, ca. 8-10 mi W of Rancho Cerro de la Madera, in *Pinus arizonica*, *Quercus*, *Arbutus*, *Fraxinus* woodland with *Garrya*, *Rhamnus*, etc., 2000-2600 m, 27° 07' N, 102° 31' W, 2 May 1977, *Henrickson 16009a* (TEX); E slope of the Sierra de San Marcos, ca. 6 km S of Ejido La Noria, 26° 28' 30"-26° 26' N, 101° 35' W, steep limestone slopes, *Dasyllirion*, *Agave lechuguilla*, *Agave asperima*, *Yucca carnerosana*, *Quercus*, *Pinus*, 1400-2275 m, 20 Mar 1973, *Johnston et al. 10305a* (TEX); Sierra de la Madera, middle and upper reaches of Cañon de la Hacienda, 27° 02' 30"-27° 03' 30" N, 102° 26' 30" W, steep limestone and shaly limestone slopes, *Pinus* spp., *Pseudotsuga*, *Quercus* spp., *Cercocarpus*, *Arctostaphylos*, 1850-2550 m, 10 May 1973, *Johnston et al. 10952a* (TEX); Cañon de la Gavia above (S of) Rancho de la Gavia, 26° 18' 30"-26° 20' N, 101° 15'-101° 18' W, steep-sided limestone mountain, *Quercus* sp., *Dasyllirion*, *Agave lechuguilla*, *Cercocarpus*, *Fraxinus greggii*, *Pinus cembroides*, 1250-2200 m, 2-3 Aug 1973, *Johnston et al. 12059a* (TEX); Cuatro Ciénegas Basin, Sierra de San Marcos, opposite Los Fresnos, NE-facing slope, 4 Apr 1969, *Pinkava et al. P-6117* (ASU digital image!, UC); Cañon de la Hacienda, Sierra la Madera, NW of Cuatro Ciénegas, conifer-oak forest above log-cutter's camp, 23 Jun 1976, *Pinkava et al. P-13638* (ASU digital image!, UC); Sierra de Arteaga, Las Vigas, Cañon de Jamé, 25° 20' N, 100° 39' W, bosque de *Pinus*, *Pseudotsuga*, *Abies*, *Quercus*, y *Ceanothus*, vegetacion subalpina con *Pinus culminicola*, 2600-3300 m, 16 Sep 1989, *Villareal & Carranza VQ5166* (TEX); Sierra de la Madera, Cañon de la Hacienda (N-draining) S of upper woodcutters' camp along E-fork



trail on first level "bench" on ridge between E and W fork, 27° 02' 41" N 102° 25' 25" W, woods with *Cupressus arizonica*, *Quercus* spp., *Arbutus*, *Garrya*, *Ceanothus coeruleus*, *Pinus arizonica*, 2200 m, 16 Aug 1975, *Wendt 1148* (LL). **Nuevo León**. Sierra Madre Mts., Monterrey, 29 Jul 1933, *Mueller 216* (TEX).

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## ***SALVIA VIRGATA* (LAMIACEAE) NATURALIZED IN TEXAS**

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### **ABSTRACT**

*Salvia virgata*, a native of Asia and Europe, is documented from two populations as adventive in Kerr County, Texas. This mint is also known to be naturalized in California, where it is included in the state noxious weeds list.

**Key Words:** Lamiaceae, Labiatae, *Salvia*, Kerr County, Texas, United States.

*Salvia virgata* Jacq. (Lamiaceae), commonly known as wand sage or southern meadow sage (Fig. 1), is a perennial plant native to southeast Europe and southwest Asia, the distribution being essentially from Italy east to Pakistan (USDA, ARS (GRIN) 2012). In the United States, *S. virgata* has been documented in California, where it is included in the California State Noxious Weeds List (fide USDA, NRCS 2012). The species also is considered to be a weed by USDA, ARS (GRIN) (2012), apparently based upon the California disposition and the potential of the plant to become a seed contaminant. The species occurs at elevations between 270–830 m in the eastern Klamath Range, Cascade Range, and northern Sierra Nevada Range of California (Jepson Flora Project 2012).

In Texas, *Salvia virgata* was discovered in two locations in Kerr County, which is located in the Edwards Plateau vegetational area of the state (Gould 1962). These two locations, ultimately part of the Guadalupe River drainage, are about 3.4 km distant from each other. Both Texas populations presumably represent escapes from cultivation.

Voucher specimens: USA. Texas. Kerr Co.: 1.8 mi. NW of Ingram, 0.2 miles E of the jct. of Texas Hwy 27 and Ingram Hills Road, along right of way of Ingram Hills Road, 13 Apr 2012, *Susan Sanders s.n.* (BAYLU); 0.7 mi. W of Ingram, 0.1 mi. S of jct. of Texas Hwy 39 and Point Theatre Road on Point Theatre Road, on a 9 m bluff along Johnson Creek at confluence with the Guadalupe River, 12 Jul 2012, *Susan Sanders s.n.* (BAYLU).



Figure 1. *Salvia virgata* Jacq. from Kerr County, Texas (photo by Susan Sanders).

The first site (Ingram Hill Road), where plants were discovered but not collected in 2002, is in the flood plain of Henderson Branch Creek on Ingram Hills Road. When the plants were first discovered, the population comprised an estimated of 20–25 individuals. On 16 April 2012, the location was revisited and the number of individuals estimated to be slightly over 100, spaced 0.6–2.4 meters between individuals. Associated flora included *Bothriochloa ischaemum*, *Thymophylla pentachaeta*, *Stenaria nigricans*, *Solanum elaeagnifolium*, *Gaura* sp., and *Phyla* sp.

The Point Theatre Road site is adjacent to Johnson Creek and covers an area of about 37 square miles. Between 300–400 individuals were at this site. Associated flora included *Elymus virginicus*, *Nassella leucotrichia*, *Calypocarpus vialis*, *Lepidium virginicum*, and *Quercus buckley*.

The plants, which are rosulate, had taproots averaging about 15.2 cm in length. This may indicate that *Salvia virgata* has access to deeper soil moisture during dry weather events, thereby increasing survivability in this area that averages about 64 cm of rain per year (value from Map 3,

Correll & Johnston 1970). Survivability should be furthered at both sites because of the alluvial soils, which should hold moisture for a longer period after rain events than does the surrounding, more elevated landscape.

Turner et al. (2003) included distribution maps for 23 species of *Salvia* in Texas, with no species being included in the list of adventives. Correll and Johnston (1970) treated 22 species of *Salvia* in the state, with one species, *S. hispanica* L., not considered native.

#### ACKNOWLEDGEMENTS

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# TAXONOMY OF *APIASTRUM*, *AMMOSELINUM*, AND *SPERMOLEPIS* (APIACEAE)

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## ABSTRACT

A taxonomic summary is given for the three closely related and primarily North American genera *Apiastrum* (1 species), *Ammoselinum* (3 species), and *Spermolepis* (11 species). *Apiastrum* includes the single species *A. angustifolium*, which occurs in California, Baja California, and Baja California Sur. *Ammoselinum* includes *A. rosenfurtii* (endemic to Uruguay) and the North American *A. butleri* and *A. popei*. *Spermolepis* includes one species endemic to the Hawaiian Islands—*S. hawaiiensis*, one species endemic to Argentina—*S. castellanensis*, and nine species native to North America: *S. echinata*, *S. inermis*, *Spermolepis organensis* Nesom, sp. nov. (Dona Ana Co., New Mexico), *Spermolepis laevis* Nesom, sp. nov. (central Texas to south-central Oklahoma), *S. divaricata*, *Spermolepis* (*Leptocaulis*) *diffusa* (Nutt. ex DC.) Nesom, comb. nov., *Spermolepis* (*Ammoselinum*) *gigantea* (Coulter & Rose) Nesom, comb. nov., *Spermolepis lateriflora* Nesom, sp. nov. (California, Arizona, New Mexico, Texas, Chihuahua, and Sonora), and *Spermolepis infernalis* Nesom, sp. nov. (San Diego Co., California). Species descriptions and keys to the genera and species are provided and a discussion of inflorescence architecture points out distinctions within and among the genera; most of the species are illustrated by photos of specimens. An epitype is designated for *Spermolepis hawaiiensis*; lectotypes are designated for *Apiastrum latifolium* (a synonym of *Apiastrum angustifolium*), *Ammoselinum popei*, *Ammoselinum castellanensis*, *Ammoselinum* sect. *Hesperoselinum*, the genus *Leptocaulis* (a synonym of *Spermolepis*), and *Spermolepis* (*Leptocaulis*) *diffusa*.

**KEY WORDS:** *Apiastrum*, *Ammoselinum*, *Spermolepis*, Apiaceae, inflorescence architecture

The genera *Apiastrum*, *Ammoselinum*, and *Spermolepis* are very similar among themselves and are all placed in tribe Selineae (Downie et al. 2010) of subfamily Apioideae. The species are primarily North American but *Ammoselinum* and *Spermolepis* each include a South American species and *Spermolepis hawaiiensis* is endemic to Hawaii. The monospecific *Apiastrum* is restricted to Pacific coastal region of Mexico (Baja California and Baja California Sur) and California. Plants of *Ammoselinum* and *Spermolepis* are annuals with narrow, characteristically linear to filiform leaf segments, narrow involucre bractlets but lacking an involucre, white petals with straight apices, laterally compressed fruits, narrowly conical stylopodium, and styles absent, the sigmas divergent. *Apiastrum* is similar but apparently is specialized in its lack of sepals, stylopodium, and involucre bractlets and its branching-inflorescence architecture. Loss of peduncles has occurred in some species of all three genera.

1. Medial and distal leaves appearing opposite; schizocarps depressed-ovoid, 1–1.5 mm; sepals absent; stylopodium obsolete, styles filiform; involucre bractlets absent ..... **Apiastrum**
1. Leaves alternate; schizocarps broadly ovoid to ovoid-oblong, urceolate-ovoid, or urceolate-oblong, 1.5–5 mm; sepals small but present; stylopodium present, styles obsolete; involucre bractlets present.
2. Schizocarp ovoid-oblong to urceolate-ovoid or broadly ellipsoid, ribs sparsely to densely scaberulous with single-celled papilla-like projections ..... **Ammoselinum**
2. Schizocarp broadly ovoid to ellipsoid or elliptic-ovoid, ribs and intervals variously hairy or at least tuberculate ..... **Spermolepis**

In maintaining *Ammoselinum* and *Spermolepis* as separate genera in the present manner, the definition of *Ammoselinum* is narrowed to only the three species with mericarps scabrous-ribbed, otherwise glabrous, and with corky-expanded, appendage-like lateral ribs (Fig 1). Those species without expanded lateral ribs and with hairs or at least tubercles on both the ribs and intervals are referred to *Spermolepis*.

Considerable variation in fruit shape and vestiture also exists among the species of *Spermolepis* as accepted here (Fig. 1a-q). *Spermolepis gigantea* and *S. castellanosii* appear to be distinct as a pair on the basis of the relatively elongate fruits (compared to other species of *Spermolepis*), but *S. gigantea* is unique in its hispid-hirsutulous fruit vestiture with long, sharp-pointed hairs without tuberculate bases; hairs of *S. castellanosii* are similar to those of *S. infernensis*. *Spermolepis divaricata* and *S. diffusa* are distinct as a pair on the basis of their short-ellipsoid fruits with tiny upcurved hairs; they also are distinct from the rest of the genus in their relatively smooth epidermis (vs. minutely "bubbly" in the others). *Spermolepis echinata*, *S. hawatiensis*, *S. lateriflora*, *S. infernensis*, and *S. inermis* are similar in their broadly ovoid fruits with multicellular, tuberculate trichome bases and the first three species are echinate-bristly with apically hooked hairs.

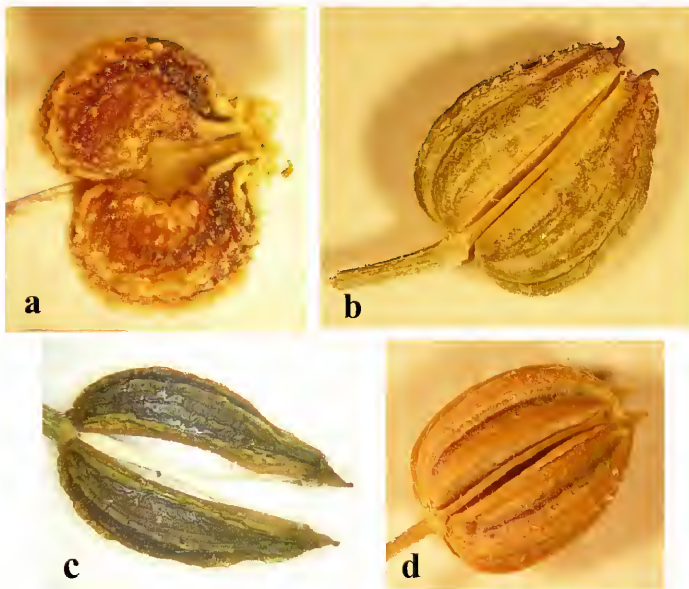


Figure 1a-u. Mature or near-mature fruits of *Apiastrum*, *Ammoselinum*, and *Spermolepis*. At approximately but not exactly the same scale (see descriptions for measurements). (a) *Apiastrum angustifolium*, (b) *Ammoselinum popei*, (c) *Ammoselinum rosenfurtii*, (d) *Ammoselinum butleri*.

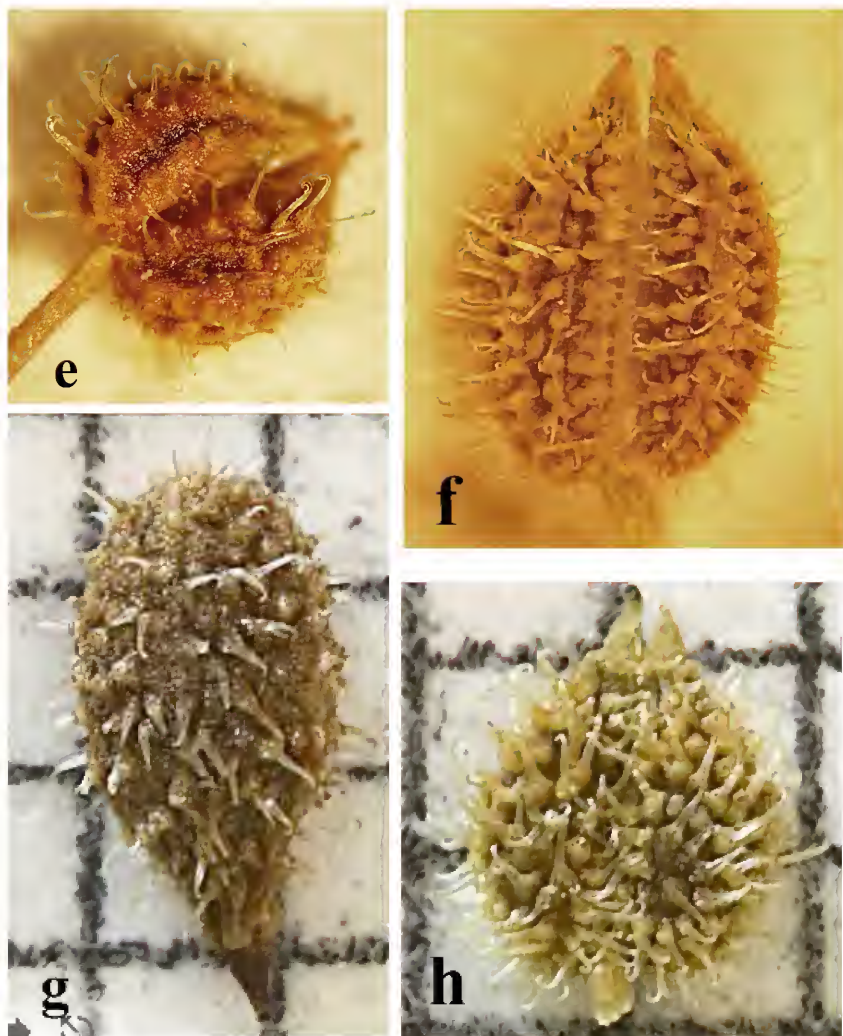


Figure 1e, f, g, h. (e) *Spermolepis echinata*, (f) *S. lateriflora*, (g, h) variants of *S. hawaiiensis*.

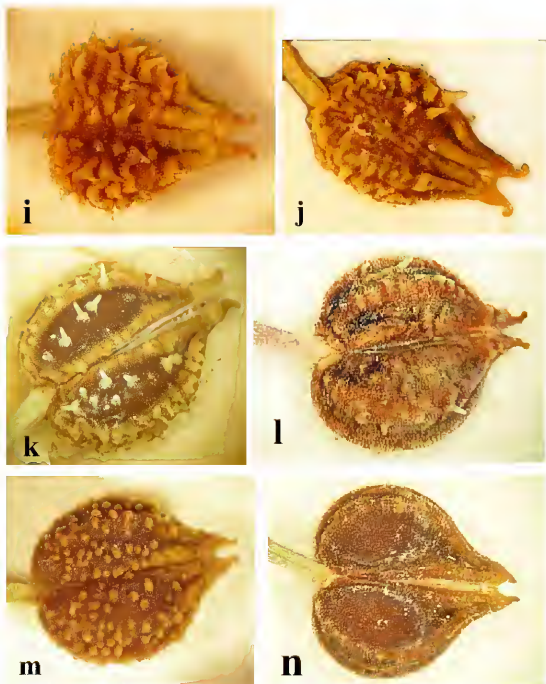


Figure 1i, j, k, l, m, n (i) *Spermolepis echinata* variant, possibly mutant, Whitehouse 9828, from Wilbarger Co Tex , see text (j) *S. echinata* x *S. inermis*?, Cory 48795, from Wilson Co. Tex , see text, (k) *S. infernalis*, (l) *S. organensis*, (m) *S. mermis*, (n) *S. laevis*.



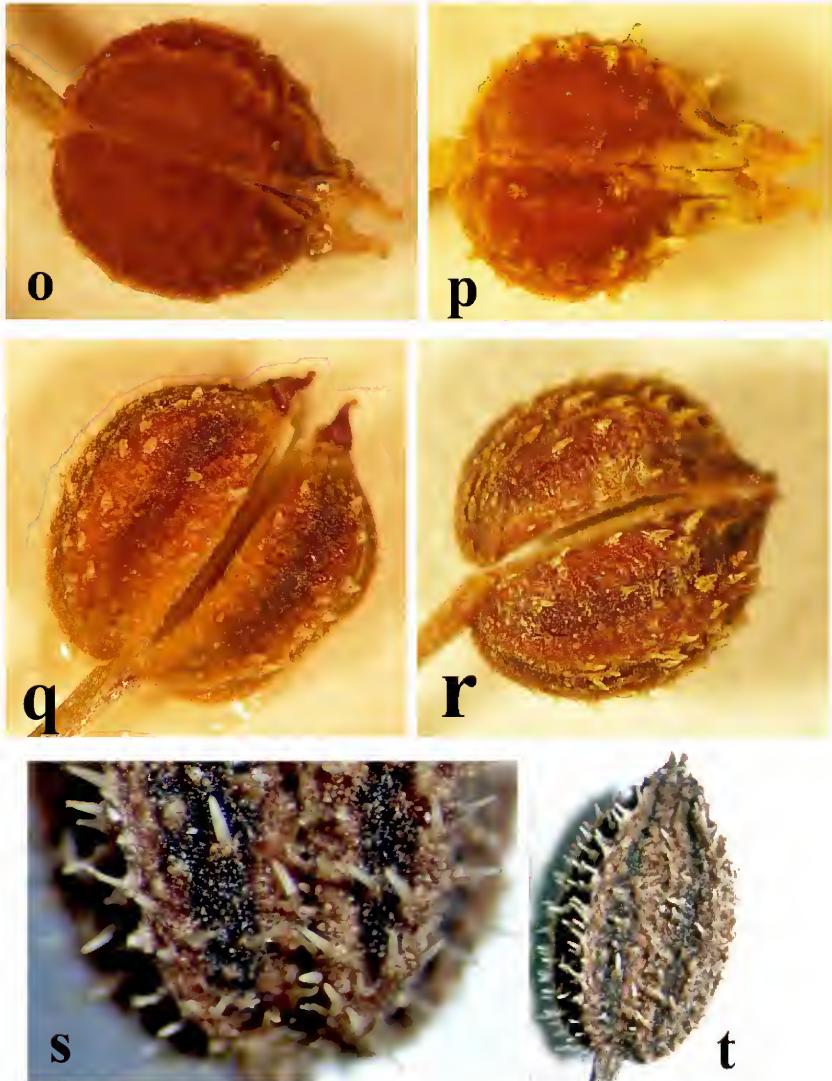


Figure 10. p, q, r, s, t. (o) *Spermolepis laevis* variant with slightly rugulate ribs and intervals - Wolff 2102, (p) *S. laevis* variant with a few tubercles, some with short, blunt-tipped hairs - Whitehouse 18439, (q) *S. divaricata*, (r) *S. diffusa*, (s, t) *S. castellanosi*.



Figure 10. *Spermolepis gigantea* (at much larger scale than the other fruit photos)

Among the genera of tribe Selineae in the account by Downie et al. (2010), *Oligoclados* Chadat & Wilczek is the only other American genus in the tribe outside of the “*Arvacacia* Clade” and the “Perennial Endemic North American Clade” — except for *Ammoselinum* and *Spermolepis* — all other genera are Eurasian. *Oligoclados* includes only the single species *O. patagonicus* (Speg.) Perez-Mor (synonym = *O. andinum* Chadat & Wilczek), which apparently is restricted to Argentina. Mainly because of its dorsally compressed fruits (flattened parallel with the plane of the commissure) with numerous oil tubes on the broad commissural face, Mathias and Constance (1950) eliminated *Oligoclados* as a possible congener or even close relative when considering the generic placement of their new species *Ammoselinum rosengurtii* (see illustrations of *O. andinum* in Chadat and Wilczek 1982, pp. 527–528, vs. lateral compression in the *Apurshura*–*Ammoselinum*–*Spermolepis* group, flattened perpendicular to the plane of the commissure).

The base chromosome number of the *Apurshura*–*Ammoselinum* and *Spermolepis* group appears to be  $x = 11$  as it appears in all three genera, with reductions to  $x = 10$  and  $x = 8$ . Among the uninate bristly species of *Spermolepis*, three dysploid levels exist:  $2n = 22$  (*S. arizonicensis*),  $2n = 20$  (*S. schinifolia*), and  $2n = 16$  (*S. lateryllifolia*). If the uninate bristly species represent a single clade, then the dysploid changes appear to be more indicative of individual speciation events than consistent

indicators of cladistic relationships. Interesting research remains to be done with regard to chromosome numbers (see comments following *S. divaricata*).

A close relationship among the 13 species of *Apiastrum*, *Ammoselinum*, and *Spermolepis* is suggested by morphological similarities as well as their general geographic coherence in a broad region (North America, South America) where other potentially related species apparently do not exist. It would not be indefensible to treat all 13 species within a single genus.

### Branching pattern and umbel architecture

In all species of *Ammoselinum* except one and in two species of *Spermolepis*, umbels are borne on ebracteate peduncles that appear to originate only at leaf axils (Fig. 2A). Growth is indeterminate, as upward vegetative growth is continued even at the distalmost node. In these plants, however, the peduncle appears to be the extension of the primary ("pr") stem axis. Continued upward stem growth and production of additional umbels continues from growth of the axillary ("ax") bud. In this interpretation, the umbels actually are produced as terminal structures, rather than axillary ones.

In *Ammoselinum butleri*, *Spermolepis lateriflora*, and *S. infernalis*, the peduncle is absent (presumably suppressed) and the umbellet rays appear to arise from the leaf axils (Fig. 2C). The axillary bud in these plants apparently is suppressed at the distalmost node, so that growth may be characterized as determinate. Peduncle suppression is complete in *A. butleri* but in *S. lateriflora*, apparently over its whole geographic range, some plants produce pedunculate umbels from nodes below the distalmost (see Figures 7 and 8 and examples cited below, under the species).

In *Spermolepis divaricata*, *S. diffusa*, and *S. inermis*, the primary axis at each node forms a peduncle and compound umbel, but on the branch arising from the distalmost axillary bud, both the terminal leaf and the axillary bud are suppressed (Fig. 2B). In effect, each branch terminates in two compound umbels and growth may be characterized as determinate.

In *Apiastrum angustifolium*, leaves appear to be opposite and two branches and two sessile (compound) umbels arise at each node (Fig. 2D). In the interpretation here, this arises from (a) suppression of the peduncles, (b) complete foreshortening of the distal internode that would constitute the axillary axis, and (c) duplication of the axillary bud in order that growth continues from two upward branches. Axillary buds apparently are suppressed at the distalmost node and growth may be characterized as determinate.

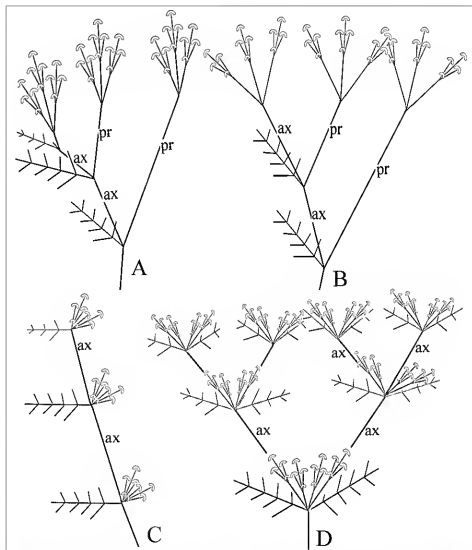


Figure 2. Variation in inflorescence architecture in *Ammoselinum*, *Aplastrum*, and *Spermolepis*. A. Pedunculate-axillary-indeterminate: *Ammoselinum popei*, *Ammoselinum rosenburgii*, *Spermolepis echinata*, *S. hawaiiensis*, *S. castellanosi*. B. Pedunculate-axillary-determinate: *Spermolepis divaricata*, *S. diffusa*, *S. merrii*, *S. laevis*, *S. organensis*, *S. gigantea*. C. Sessile-axillary-determinate: *Ammoselinum butleri*, *Spermolepis lateriflora*, *S. infernalis*. D. Sessile-dichotomous-determinate: *Aplastrum angustifolium*. "ax" = axillary branch, arising from the axillary bud. "pr" = primary branch, continuing from the main branch from below. In determinate arrangements, the axillary bud is suppressed at the distalmost node.

**APIASTRUM** Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1: 643. 1840. TYPE: *Apiastrum angustifolium* Nutt. ex Torr. & A. Gray

Herbs, annual, with odor, 0.4–5 dm, glabrous; taproot slender. Leaves appearing opposite to subopposite medially and distally; basal and cauline 3–4 ternately compound; blades broadly ovate to ovate in outline, herbaceous; leaflets divided, ultimate divisions linear to narrowly oblong, margins entire; petioles scarious margined at base, distal petioles foreshortened and scarious-margined along whole length. Umbels compound, loosely convex, axillary, sessile (rays appearing to arise from leaf axils), peripheral flowers not different; involucre bracts absent; involucre bractlets absent. Pedicels present. Flowers bisexual; sepals absent; petals white, margins, entire, apices slightly inflexed; stylopodium depressed-reduced, nearly obsolete; styles evident, filiform, 0.2 mm, arching-divergent. Schizocarps depressed-ovoid [mericarps reniform], laterally compressed, not beaked, splitting, ribs 3, barely raised, mostly delimited by line of papillae, oil tubes 1 per interval, filiform not filling the interval, surface shallowly tuberculate, otherwise glabrous; carphophore bifid the whole length. Base chromosome number,  $x = 11$ .

1. *Apiastrum angustifolium* Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1(4): 644. 1840. TYPE: USA. California. [San Diego Co.:] St. Diego, N Cal, April, *T. Nuttall s.n.* (probable holotype: GH 00075076; isotypes: K digital image!, PH 01015720 digital image!).

*Apiastrum angustifolium* var. *tenellum* Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1(4): 644. 1840. TYPE: MEXICO. Baja California. Cerro [Cedros] Island, Mar 1889, *E. Palmer s.n.* (probable holotype: PH 743994 digital image!).

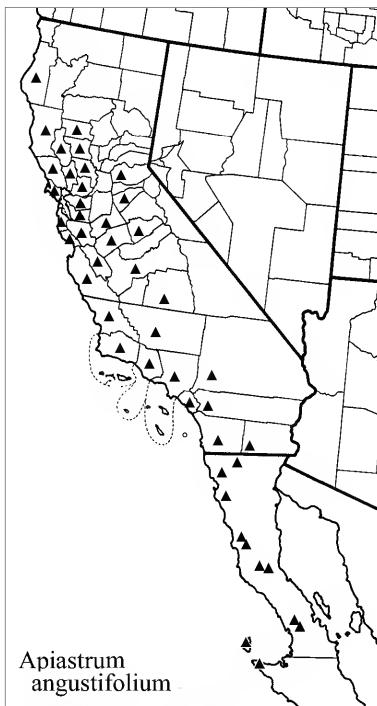
Torrey and Gray did not indicate that they saw a collection; their concept of the taxon was from Nuttall's manuscript. The plant in the PH collection matches Torrey and Gray's brief description ("stem dichotomous from the base, leaves less divided, rays of the umbel very slender, umbellets 1–2-flowered, seed more rugulose").

*Apiastrum latifolium* Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1(4): 644. 1840. LECTOTYPE (designated here): USA. California. [Santa Barbara Co.:] "St. Barbara, N Cal." [on PH sheet], no other collection data, *T. Nuttall s.n.* (GH 00075075; isolecotype: PH 01044838 digital image!). Torrey and Gray cited "Nuttall! Douglas!"

*Helosciadium leptophyllum* var. ? *latifolium* Hook. & Arn., Bot. Beechey Voy., 347. 1838. No collection was cited (pp. 347–348). The protologue gave only this: "The specimens are only in young fruit, and the segments of the upper leaves are considerably broader than in any form we have yet seen, while even the lower ones are broader than in *H. laciniatum*, DC., which we consider a mere variety of this species." As synonym of *Apiastrum* fide Mathias and Constance (1945).

Stems 4–50 cm. Leaves: blades 1–5 cm, ultimate segments 5–25 mm; petioles 20–40 mm. Peduncles absent. Umbels axillary only: involucre bracts absent; involucre bractlets absent; fruiting rays 2–5 per node (2 umbels per node), (0–)7–25(–50) mm (central umbellet sessile); umbellets 3–7 flowered; fruiting pedicels (0–)2–8(–15) mm (central 1–2(–3) flowers sessile), unequal, spreading. Schizocarps 1–1.5 mm.  $2n = 22$  (San Diego Co. – 2 counts, Bell & Constance 1957; Baja California, Constance et al. 1976). Map 1. Figure 3.

Flowering Mar–Apr. Chaparral, coastal sage scrub, blue oak savanna, rock outcrops, granite slopes, shale slopes, serpentine soil, steep slopes, recently burned areas, grassy openings, roadsides; 0–400(–1500) m. Calif.; Mexico (Baja California, Baja California Sur).



Map 1. Distribution of *Apiastrum angustifolium*

AMMOSELINUM Torrey & A. Gray, Pacif. Railr. Rep. 2(4): 165. 1855 [1857]. TYPE: *Ammoselinum popei* Torrey & A. Gray

Herbs, annual, odorless or "faintly *Pastinaca*-scented" in *A. giganteum*, 0.4–3.5 dm, glabrous but stem ridges distally scabrous; taprooted. Leaves all alternate; basal 3-ternately compound, cauline 2–3-ternately compound; blades broadly ovate to obovate, herbaceous; leaflets lobed or divided, leaflets and ultimate divisions linear to oblanceolate or subspatulate, margins entire; petioles scarious margined at base, distal petioles foreshortened and scarious-margined along whole length. Umbels compound, loosely convex, axillary, pedunculate (rays borne on an ebracteate portion of stem) or sessile (rays appearing to arise from leaf axils), peripheral flowers not different; involucre bracts absent; involucre bractlets distinct, linear, entire or less commonly 2–3-fid, herbaceous. Pedicels present. Flowers bisexual; sepals obsolete or greatly reduced and barely evident; petals white, margins entire; stylopodium narrowly conical; styles obsolete, stigmas directly atop stylopodium and divergent. Schizocarps ovoid-oblong to urceolate-ovoid or broadly ellipsoid, 2–5.3 mm, laterally flattened, base shallowly rounded to truncate, apex not beaked, mericarps splitting, dorsal ribs 3, corky-thickened or thin, lateral corky-thickened with an appendage-like growth incurving over the commissure, dorsal oil ducts 1 or 3 per interval, 1 or 2 on the commissure, ribs scabrous with rounded to blunt single-celled, irregular, papilla-like projections; commissure sulcate; carpophore bifid only distally or along the whole length. Base chromosome number,  $x = 11$ .

#### KEY TO THE SPECIES

1. Umbels epedunculate (sessile, rays appearing to arise from leaf axils); schizocarps 2–2.2 mm, dorsal ribs acute ..... 1. *Ammoselinum butleri*
1. Umbels pedunculate (rays borne on an ebracteate portion of stem); schizocarps 3–4(–5) mm, dorsal ribs rounded or acute.
  2. Mature fruits tan; ribs usually corky-thickened, not thin and wing-like; North America ..... 2. *Ammoselinum popei*
  2. Mature fruits blackish; ribs thin, wing-like; South America ..... 3. *Ammoselinum rosenfurtii*

1. *Ammoselinum butleri* (Engelm. ex S. Wats.) Coulter & Rose, Bot. Gaz. 12: 294. 1887. *Apium butleri* Engelm. ex S. Wats., Proc. Amer. Acad. Arts 21: 453. 1886. LECTOTYPE (Coulter & Rose 1900, p. 90): USA. Texas. Harris Co.: near Houston, 29 Mar 1872, E. Hall 244 (GH; isoelectotypes: BM digital image!, K digital image!).

Watson cited three collections: (1) "Texas, in wet grounds near Houston, E. Hall (n. 244), March, 1872"; (2) "near Dallas, J. Reverchon [s.n.], March and April 1874", and (3) "Indian territory, south of the Arkansas, G.D. Butler [s.n.], 1876". Coulter and Rose (1900) noted that "The type here given is the first specimen cited" but they clearly referred to it as the type and to the Reverchon and Butler collections as "associated with it in the original description".

Stems 4–10 cm, branching from the base. Leaves: blades oblong to oblong-ovate in outline, 10–25 mm, ultimate divisions 1–8 mm; leaflet and bractlet margins and midrib smooth to very sparsely scabrous; petioles 5–30 mm, clasping to auriculate-clasping, scarious-margined at the base. Inflorescence axillary, indeterminate. Peduncles absent (rays appearing to emerge from the leaf axils). Rays (1–)2–4, (0–)0.5–4(–7, very rarely to 15) mm. Umbellets (1–)3–5-flowered (central umbellet often 1-flowered); pedicels (0.5–)1–3(–4) mm (central flower sessile). Involucre bractlets 1–4, linear, rarely 2-fid, 0.5–2 mm, without scarious margins. Schizocarps ovoid-oblong, 2–2.2 mm, dorsal ribs acute, sparsely papillate-scarious with minute, translucent, apparently 1-celled, conical, apically acute, papilla-like hairs, lateral ribs slightly corky-thickened, barely raised; oil tubes 1 per interval, filiform but usually clearly evident, 2 on the commissure; carpophore bifid in distal 1/4. Chromosome number not reported.

Flowering Mar–Apr. Sandy and sandy clay soil, gravel piles, lawns, old fields, roadsides, cultivated fields, pastures, fencerows, stream and pond edges, shell banks, oak-juniper glades, limestone prairies; 100–300 m; Ala., Ark., Kans., La., Miss., Mo., N.C., Okla., Tenn., Tex.

Almost all habitats recorded for *Ammoselinum butleri* have been described in some sense as "disturbed" — some of those in Texas (glades and prairies) apparently are undisturbed. The species has only recently expanded into Alabama, Mississippi, and North Carolina (Boufford 1977; Bryson 1991; Keener 2007).

2. *Ammoselinum popei* Torrey & A. Gray, Pacif. Railr. Rep. 2(4): 165. 1855 [1857]. *Apium popei* (Torrey & A. Gray) A. Gray, Proc. Amer. Acad. Arts 7: 343. 1868. LECTOYPE (designated here): USA. Texas. Headwaters of the Colorado, 13 Apr 1854, *J. Pope s.n.* (NY digital image!). At GH is another Pope specimen, labeled "Mar-Apr, Llano Estacado," this may be a duplicate of the NY sheet, but it is not clear.

The protologue has this "Sandy soil; Llano Estacado, and head-waters of the Colorado [collections by 'Captain Pope'], March and April Mr Wright found it in Western Texas, but he collected only a few specimens, and it was not distributed with his plants. Some ripe seeds that he collected were cultivated in the Cambridge Botanic Garden, and arrived at perfection. Dr. Parry, while engaged on the Mexican boundary survey, under Major Emery, sent home a single flowering specimen of the plant, found at Eagle Pass in January, 1853. From no other sources have we received any specimens of this apparently new genus."

**Stems** 8–35(–60) cm, branching from the base. **Leaves:** blades oblong-ovate in outline, 10–40 mm, ultimate divisions 2–10 mm; leaflet and bractlet margins and midrib prominently scabrous. **Petioles** 5–60 mm, clasping to auriculate-clasping, scarious-margined at the base. **Inflorescence** axillary, indeterminate. **Peduncles** 25–75 mm. **Rays** (5)–6–10, (0)–6–25 mm (inner umbellet sessile). **Umbellets** 4–9 flowered; pedicels (0)–2–5 mm (inner flower sessile to subsessile). **Involucel bractlets** 1–6, linear and entire or less commonly 2–3-fid, 2–12 mm, usually scarious-margined at the base. **Schizocarps** urceolate-oblong, 3–4(–5) mm, dorsal ribs rounded, densely and coarsely papillate-scaberulous with translucent, multicelled, convex, apically rounded, papilla-like hairs, lateral ribs corky-thickened and raised and obscuring the commissural face; oil tubes 1 per interval, barely evident between the thickened ribs, commissural usually not evident; carpophore bifid along whole length. **Chromosome number** not reported.

Flowering (Mar–)Apr–May. Sandy soil, rocky soil, rock outcrops, roadsides, pastures, lake edges, dunes, gypsum flats, limestone barrens, cedar glades, mesquite savannas, gypsiferous, calcareous, and black clay prairies; 0–800(–1300) m; Kans., N.Mex., Okla., Tenn., Tex.; Mexico (Coahuila, Nuevo León, Tamaulipas).

The disjunct populations in central Tennessee (5 counties, see TENN 2012) are typical in morphology and apparently native there.

An epetiolate leaf rarely is produced at the base of a cluster of rays. This is a consistent feature in the plants of *Tolstead 7015* (SMU) from Taylor Co., Texas.

Collections examined. **USA. New Mexico, Eddy Co.:** Carlsbad Cavern Natl. Park, road to sewage lagoon just across E boundary of park, SW of Whites City, bajada below escarpment, xeric shrubland, *Larrea-Gutierrezia* community, ca. 3640 ft, 19 Apr 1977, *Burgess 4449* (TEX); Carlsbad City Lake and park on the Pecos River, wet sandy loam, 20 Apr 1966, *Crutchfield 1336* (LL); Lincoln Natl. Forest, Sitting Bull Falls, growing in lawn at picnic site near trail to falls, 4595 ft, 21 Apr 2011, *Heil 33359A* (SJC). **Lea Co.:** City of Hobbs, jet of US 62-180 and the hwy to Lovington, lawn of convenience store, 3670 ft, 23 May 2011, *Heil & O'Kane 33424* (SJC); Hobbs, near Humble City,



entrance to Ocotillo Golf Course, weedy sites, disturbed sites, 3700 ft, 20 Apr 2011, *Heil* 33347 (SJC). *Otero Co.*: Escarpment and canyon in limestone plateau ca. 11 air mi NE of Dell City, 3.3 road mi N and then NE from the TX/NM state line and E from hwy up canyon for 0.75 mi, on alluvium below limestone slopes, 3706 ft, roadside plants, 2 May 1999, *Worthington* 28247 (UCR, fide SEINET).

Collections examined. **MEXICO. Coahuila.** Musquiz, 12 Apr 1936, *Marsh* 2097 (TEX); Musquiz, Apr 1938, *Marsh* 1132 (TEX); 56 mi S of Eagle Pass, Texas, rocky slope, 3 April 1969, *Pinkava* 15576 (ASU digital image!); Rio Grande valley, near Diaz, 700 ft, 15 Apr 1900, *Pringle* 8314 (MO digital image!). **Nuevo León.** 2 mi N of Sabinas Hidalgo, sandy loam bottom, 26 Mar 1944, *Barkley* 14521B (TEX); 23 mi N of Sabinas Hidalgo, limy clay hillside, 26 Mar 1944, *Barkley* 14592 (TEX); 5 km N of Sabinas Hidalgo on Hwy 85, dry but verdant wash leading from apparently irrigated field, surrounding vegetation of *Acacia-Prosopis*, 310 m, 23 Mar 1986, *Nesom* 5350 (TEX); Mpio. Higuera, Cuesta Mamulique, ca. 40 km S of Sabinas Hidalgo on Mex 85, W side of "Libre" Hwy, near top of ridge of dirt road toward microwave tower, area of *Acacia* and other genera of shrubs, ca. 540 m, 26 Mar 1993, *Nesom* 7553 (TEX); fields near Monterrey, 1800 ft, 6 Apr 1906, *Pringle* 13747 (LL, TEX). **Tamaulipas.** 10 mi S of Nuevo Laredo, dry flat, 26 Feb 1944, *Barkley* 14322 (TEX); 3 mi SW of El Canelo at lat. 25° 09' on the Matamoros-Victoria hwy, clay roadside ditch, 50 ft, 9 Feb 1960, *Johnston* 5077C (TEX).

3. *Ammoselinum rosenfurtii* Mathias & Constance, Bull. Torrey Bot. Club 77: 133, fig. 1. 1950. TYPE: URUGUAY. Depto. Florida, Estancia Rincon de Santa Elena, Picada Castro, Arroyo Mansavillagra, 8 Nov 1946, B. *Rosenfurt* *Gallinal* 5753 (holotype: UC! digital image!; isotype: LA).

**Stems** ca. 4–8(–10) cm tall, simple or few-branched mostly at 1 or 2 nodes above the base; "from a *Daucus*-scented taproot" (Rosenfurt in 1969) **Leaves:** blades broadly ovate in outline, 25–40 mm, ultimate divisions 4–8 mm, scaberrulous on margins and nerves; petioles 7–10 mm, scarious-margined along whole length. **Peduncles** 20–50 mm. **Rays** 2–5, 1–20 mm (inner 1–2 umbellets short-pedicellate). **Umbellets** (1–)3–5-flowered, pedicels 2–7(–10) mm (central flower short-pedicellate). **Involucel bractlets** 3–4, linear-lanceolate, entire, 1.5–7 mm, unequal, without scarious margins. **Schizocarps** ellipsoid, attenuate toward the apex, 3.2–5.3 mm, densely scabrous on the angles with thick, sharp-pointed, pustulate-based hairs, dorsal ribs 3, rounded, lateral ribs; oil tubes 3 per interval, 2 on the commissural face; carpophore bifid along whole length.  $2n = 44$  (from *Rosenfurt s.n.*, 1969, see citation below; Constance et al. 1976). Figures 4, 5.

Flowering Oct–Dec. Habitat?; ca. 100–200 m; South America (Uruguay).

Additional collection examined. **Uruguay.** Depto. Rocha, Sta. Teresa, Dec 1969, *Rosenfurt s.n.* (TEX), chromosome voucher cultivated in Univ. of California Botanical Garden C-1721. Also see photos on Flickr (González 2010).

*Ammoselinum rosenfurtii* apparently is known only from Uruguay (Mathias & Constance 1950); the protologue cited collections from provs. Artigas, Cerro Largo, Florida, Paysandú, Rio Negro, Salto, and Soriana. Photos by Andrés González were taken "al margen del Río Negro cerca al dique de la Represa Constitución, departamento de Río Negro."

*Ammoselinum rosenfurtii* is similar to *A. popei* especially in its papillate-scabrous vestiture, urceolate-oblong fruits with expanded lateral ribs, and carpophore divided along the whole length. It differs from *A. popei* in its dark fruits, thin-winged fruit ribs, and three oil tubes per dorsal interval.

**SPERMOLEPIS** Raf., Neogenyton, 2. 1825. TYPE: *Spermolepis divaricata* (Walt.) Raf. ex Seringe In the protologue, Rafinesque noted "Type, a plant put in four genera already! *Sison pusillum*, Mx. *Daucus divaricatus*, Walt. Ammi do [*divaricatum*] Pers and *Ligusticum pusillum* Pers!" The nomenclatural combination in *Spermolepis* for *Daucus divaricatus* Walt. was made by Seringe in 1830, attributed by him to Rafinesque.

*Leptocaulis* Nutt. ex DC., Coll. Mém. 39, plate 10. 1829. LECTOTYPE (designated here): *Leptocaulis divaricatus* (Walt.) DC. De Candolle's discussion included, in various permutations, *Spermolepis divaricata*, *S. inermis*, *S. echinata*, and various synonyms.

Babiron Raf., New Fl. 4: 23. 1838. TYPE: *Babiron divaricatum* (Walt.) Raf. = *Spermolepis divaricata* Rafinesque included *Babiron pusillum*, *B. divaricatum*, and *B. dichotomum* — all are synonyms of *Spermolepis divaricata*.

*Lepisperma* Raf., Act. Soc. Linn. Bordeaux 6: 268. 1834. As synonym of *Spermolepis* fide Mathias and Constance 1945).

*Ammoselinum* sect. *Hesperoselinum* Munz & Johnston, Bull. Torrey Bot. Club 52: 224. 1925.

LECTOTYPE (designated here): *Ammoselinum giganteum* Coulter & Rose

After identifying their new species *Ammoselinum occidentale* Munz & Johnston as congeneric with *A. giganteum*, the authors placed the two species together in a separate section. No type was designated.

Annual herbs, slender taprooted, glabrous, not aromatic or sometimes (*S. lateriflora*) with a "carrot" odor. Stems erect, 5–80 cm, simple or few-branched from basal to medial nodes. Leaves all alternate; basal and cauline or mostly cauline, 3-pinnately compound; blades ovate to oblong to oblong-ovate in outline; leaflets filiform to linear or narrowly oblong, margins entire to weakly scaberrulous; proximal petioles scarious margined at base, distal petioles becoming much foreshortened and scarious-margined along whole length. Umbels compound, irregularly and loosely convex, terminal and axillary or axillary only, pedunculate (rays borne on an ebracteate portion of stem) or sessile (rays appearing to arise from leaf axils), peripheral flowers not different; involucre bracts absent or (*S. hawaiiensis*) sometimes present; involucre bractlets distinct, filiform or linear to linear-lanceolate, herbaceous, without scarious margins. Pedicels present or reduced to obsolete. Flowers bisexual; sepals obsolete or essentially absent; petals white, oblong or elliptic to ovate, apex not inflexed, margins entire; stylopodium conical; styles obsolete, stigmas directly atop stylopodium and divergent. Schizocarps broadly ovoid to ellipsoid or elliptic-ovoid, sometimes slightly beaked, 1.5–2(–4) mm, flattened laterally and slightly constricted at the commissure, mericarps splitting, ribs [number], filiform, oil tubes 1(–3) per interval, 2 on the commissure, surface (a) echinate-bristly with apically hooked hairs arising from rounded, multicellular bases, (b) bristly with apically straight hairs arising from rounded, multicellular bases, (c) tuberculate-roughened by rounded, multicellular projections, (tuberculae and multicellular hair bases apparently homologous), or (d) scabrous with minute, upcurved hairs not arising from a tuberculate base; commissural face sulcate; carpophore bifid in distal 1/4–1/3. Base chromosome number = 11? ( $n = 8, 10, 11, 19, 32$ ).

#### KEY TO THE SPECIES

1. Schizocarps densely echinate-bristly with sharp-pointed, apically hooked hairs.
  2. Distal umbels sessile, without a peduncle, proximal umbels sometimes pedunculate;  $2n = 16$  ..... 1. *Spermolepis lateriflora*
  2. All umbels distinctly pedunculate.
    3. Schizocarps 1.5–2 mm;  $2n = 20$  ..... 2. *Spermolepis echinata*
    3. Schizocarps 3–4 mm;  $2n = 22$  ..... 3. *Spermolepis hawaiiensis*
1. Schizocarps with apically straight hairs or lacking hairs.

4. Distal umbels sessile, without a peduncle, proximal umbels sometimes pedunculate; fruit surface tuberculate on ribs and intervals, some tubercles with apically straight hairs, some without hairs ..... 4. *Spermolepis infernalis*
4. All or most umbels distinctly pedunculate; fruit surfaces variable in vestiture.

5. Schizocarps 3–5 mm, narrowly elliptic-ovate to oblong-ellipsoid or ovoid-oblong, surface hispid-hirsutulous.

6. Hairs blunt-tipped, arising from a tuberculate base; South America ..... 10. *Spermolepis castellanosi*
6. Hairs sharp-pointed, arising from a non-tuberculate base; North America ..... 11. *Spermolepis gigantea*

5. Schizocarps 1.2–2 mm, mostly broadly ovate to broadly elliptic, surface either completely smooth, tuberculate but hairless, tuberculate with a few hairs, or sparsely to densely scabrous with minute, upcurved or upturned hairs.

7. Fruit surface ribbed but otherwise completely smooth, lacking even tubercles ..... 6. *Spermolepis laevis*
7. Fruit surface either tuberculate (with or without straight, erect hairs) or with minute, upcurved or upturned hairs.

8. Fruit surface tuberculate with multicellular trichome bases, but totally lacking hairs

9. Tubercles irregularly scattered, some with short, erect hairs; peduncles 0.9–3.5 cm ..... 7. *Spermolepis organensis*
9. Tubercles densely arranged, without hairs; peduncles 2–7 cm ..... 5. *Spermolepis inermis*

8. Schizocarps sparsely to densely scabrous with minute, 1-celled, upcurved or upturned hairs, the hairs not arising from multicellular tubercles.

10. Pedicels (0–)2–9 mm; rays 5–17 mm; central 1–2 flowers of each umbellet sessile to subsessile ..... 8. *Spermolepis divaricata*
10. Pedicels (8–)14–32 mm; rays 15–33 mm; all flowers of each umbellet with subequal pedicels, none sessile or subsessile ..... 9. *Spermolepis diffusa*

1. *Spermolepis lateriflora* G.L. Nesom, sp. nov. TYPE: USA. Arizona. Pima Co.: Rillito Valley, Tucson, 29 Apr 1905, J.J. Thorne 5241 (holotype: TEX!; isotypes: ARIZ!, RSA!, UC!).

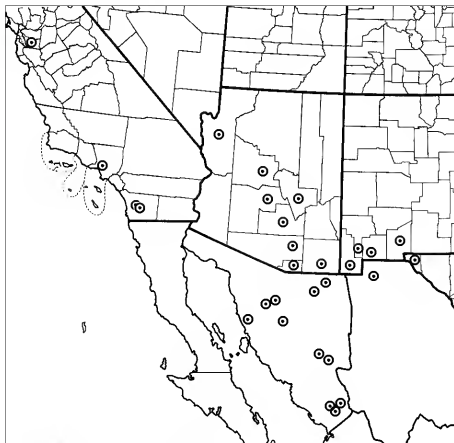
Similar to *Spermolepis echinata* (and previously identified as that species) in its fruits densely echinate-bristly with uncinata hairs but distinct in its epedunculate (sessile) umbels.

Stems 5–35 cm. Leaves: blades broadly ovate in outline, mostly 1–5 cm, finely ternately dissected, ultimate segments linear to oblong, 4–12 mm; petioles 1–3 cm. Peduncles absent or 20–70 mm. Umbels usually axillary only, usually sessile at all nodes, always sessile at distal nodes, occasionally pedunculate below the distalmost; involucre bracts absent; involucre bractlets 2–4, linear, 1–2 mm; fruiting rays 4–5 per node, (0–)1–14 mm (central 1–2 umbellets sessile to subsessile), unequal, spreading; umbellets 3–8-flowered; fruiting pedicels 1–6 mm (central 1–2 flowers subsessile). Schizocarps 2–2.2 mm, densely echinate-bristly with apically hooked hairs; oil tubes 1

per dorsal interval.  $2n = 16$  (reported as *Spermolepis echinata*, Constance et al. 1976, Pima Co., Arizona, *Gentry* 19933, ARIZ1, RSA1, UC-2 sheets!). Map 2. Figures 6, 7

Flowering Mar–Jun. Sandy, gravelly, and rocky soil, alluvium, river beds, floodplains, riparian vegetation, desert grassland, desert shrub, creosote bush flats, saltbush flats, cholla forest, mesquite scrub and woodland, oak-mesquite, oak savanna, oak-juniper woodland, (300–)700–2000 m, Ariz., Calif. (probably adventive), N.Mex., Tex.; Mexico (Chihuahua, Sonora).

Some plants produce pedunculate umbels from nodes below the distal-most, e.g., **Arizona** Pima Co. (*Gentry* 19933, UC, *Harrison et al.* 5600, ARIZ, *Shreve* 10092, UC), Maricopa Co. (*Peebles* 8475, UC). **New Mexico** Dona Ana Co. (*Jones* 26257, POM-2 sheets). **Sonora** Mpio. Soyopa, *Reina G.* 2005-56, TEX).



Map 2. Distribution of *Spermolepis lateriflora*

Additional collections examined. **USA. California** [Alameda Co.] Oakland Hills, May 1877, [*J.G. Lemmon?*] s n (UC!). Los Angeles Co. Verdugo Mountains, Tuna Canyon, shady moist banks, 1100 ft, Apr 1930, *MacFadden* 2441 (MACF digital image!). San Diego Co. due S of

Borrogo Valley, rocky terrain on alluvial slopes, 1250 ft, 30 Mar 1952, *Bacigalupi & Macbride* 3570-A (UC!); lower Box Canyon, 29 Apr 1941, *Gander* 9194 (SD fide Calif. Consortium); near base of hills S of Vallecito Stage Sta., 30 Apr 1941, *Gander* 9260 (SD digital image). Other map points are from specimens studied from ARIZ, BRIT-SMU-VDB, NMC, SRSC, TEX-LL, and UC-JEPS.

Munz and Keck (1959) identified the California plants as *Ammoselinum giganteum* (with *A. occidentale* in synonymy) but, following their identification/annotation as *Spermolepis echinata* in 1948 by Constance, they have been identified as *S. echinata* in iterations of the Jepson Manual (Constance 1993; Constance & Wetherwax 2012).

All of the California collections of *Spermolepis lateriflora* are separated from the main range of the species and all were made near urban areas (Oakland, Los Angeles, San Diego). These occurrences perhaps resulted from inadvertent recent dispersal of the echinate-bristly fruits from Arizona. CalFlora (2012) shows a number of other records (identified as *S. echinata*, apparently not vouchered) from the southwest region of the Anza-Borrogo Desert State Wilderness Park (about 50-60 miles east of San Diego) and these may be other occurrences of *S. lateriflora*. The Vallecito Stage Station (*Gander* 9260) is on the southern border of the Anza-Borrogo park. The type locality of *S. infernalis* (Hellhole Canyon Preserve, as described below), however, is in the close vicinity and the identity of these unvouchered records needs to be verified.

Additional collections examined. USA. Texas. El Paso Co.: E slope of Franklin Mt., N of El Paso, off War Road, bajada, 1 May 1970, *Correll* 38548 (LL); Franklin Mts. on trail to Cottonwood Springs, E of Canutillo, on bajada, 12 May 1959, *Correll & Johnston* 21824 (LL); 0.5 mi W of intersection of Hwy 54 and transmontane hwy, along roadside, red sandy soils, 1 Apr 1998, *Turner* 98-29 (TEX); ca. 20 mi E of El Paso, 4000 ft, 5 Apr 1958, *Warnock & Johnston* 16215 (SRSC); E slopes of Franklin Mountains, gravelly granitic soil, 20 Apr 1975, *Warnock* 23985 (SRSC); Franklin Mts., below (E) Fusselman Canyon flood control dam, 4450 ft, mixed alluvium, 1 Apr 1979, *Worthington* 4219 (TEX); Hueco Mts., Hueco Tanks State Park, N end of North Mountain in small canyon, 29 Apr 1979, *Worthington* 4407 (BRIT); Franklin Mts., E side of mts., 0.2 mi N jct Trans-Mountain Rd and War Rd, granite soil alluvial bajada, desert shrub, 4000 ft, 9 Apr 1982, *Worthington* 8071 (BRIT).

Representative collections examined (see SEINET 2012 for many others from Arizona and New Mexico). USA. Arizona. Cochise Co.: 19 mi NE of Douglas, desert grassland, 4000 ft, 17 Apr 1940, *Benson* 10298 (ARIZ); Mule Mts., waste spots, S-facing slopes, 25 Apr 1952, *Goodding* 47-52 (ARIZ). Gila Co.: Tonto National Monument, along power line, 26 Jul 2001, 740 meters, *West* 1099 (ARIZ). Graham Co.: Tanque, 1200 m, 8 May 1924, *Eggleston* 19889 (ARIZ). Maricopa Co.: Sand Tank Mts., 48 km SE of Gila Bend, small drainage, Sonoran desert scrub, 30 Apr 2003, *Baker* 15323 (ARIZ); Sonoran Desert Natl. Monument, Sand Tank Mts., summit of small peak 730 m NW of Bender Spring, 17 Apr 2001, *Felger* 01-362 (ARIZ). Mohave Co.: 7 mi S of Yucca, along sandy wash in Joshua tree-cresote bush area, 2300 ft, 12 Apr 1947, *Gould & Darrow* 4318 (ARIZ); Yucca, 14 May 1884, *Jones s.n.* (POM). Pima Co.: Fresno Canyon, 23 Apr 1932, *Harrison et al.* 8600 (ARIZ); Santa Catalina Mts., Lower Sabino Canyon, moist sand along stream, 2800 ft, 8 Apr 1946, *Gould* 3488 (ARIZ); Coronado Natl. Forest, S on State Hwy 83, ca. 13 mi from Interstate 10, open pastures, 1400 m, 19 Apr 1998, *Schmidt & Merello* 2670 (BRIT, RSA, DNA sample). Pinal Co.: Gila River bottom near Sacaton, 23 Feb 1926, *Porter et al.* 863 (ARIZ); Oracle, 12 May 1905, *Thornber s.n.* (ARIZ). Santa Cruz Co.: Nature Conservancy Patagonia-Sonoita Creek Sanctuary, SW of Patagonia, ca. 4000 ft, 30 Apr 1977, *Fay* 241 (ARIZ); 2 mi E of Nogales of Patagonia road, gravel along roadcut, 3800 ft, 9 May 1945, *Gould & Pultz* 3093 (ARIZ). Yavapai Co.: Bald Hill, mouth of West Cochise Stronghold, flats of mouth of canyon, 11 Apr 1960, *Goodding* 49-60 (ARIZ); Congress Junction, 3000 ft, 4 May 1903, *Jones s.n.* (POM). New Mexico. Dona Ana Co.: White Sands Missile

Range, Gate 4, up road ca. 1 mi "Anemone Ridge," ca. 2 mi N of US 70, just E of San Augustin Pass, Chihuahuan Desert Scrub community, monzanite boulders, 4500 ft, 22 Mar 2010, *Heil & Anderson 32092* (SJC); W base of Organ Mtns, at the mouth of Dripping Springs Canyon, 11 mi E of northern Las Cruces, about 1/4 mi W of the ruins of an abandoned resort hotel [Van Patten's], plants very common in a flat, unshaded area at the mouth of a rocky arroyo, 6000 ft, with *Erigeron nudiflorus*, *Cercocarpus*, *Fallugia*, *Celtis* and *Opuntia*, 25 April 1982, *Ward & Soreng 82-009* (NMC); in the Mesilla Valley; near Las Cruces, ca. 3850 ft, 8 April 1907, *Wootton & Standley s.n.* (NMC). *Grant Co.*: 1 mi S of Gila, gravelly mesa slope, 21 May 1935, *Maguire et al. 11530* (ARIZ); 1 mi S of Red Rock, gravelly mesa top, assoc. *Prosopis* and *Opuntia*, 21 May 1935, *Maguire et al. 11530* (UC). *Hidalgo Co.*: State Hwy 92 to Virden, ca. 2.5 mi N of US 70, roadside alluvial soils, desert grassland with scattered creosote, 4085 ft, 20 Mar 2010, *Heil 32041* (SJC); BLM, Gila Lower Box fishing area, along Gila River and rocky hills above river, riparian community and desert grassland, 4000 ft, 28 Apr 2010, *Heil & McClain 32322* (SJC); San Simon Valley between Rodeo and Arizona-New Mexico line, fine textured soils of the valley bottom in desert grasslands, 4100 ft, with *Hilaria mutica*, *Scleropogon brevifolius*, *Bouteloua eriopoda*, *Ephedra trifurca*, *Prosopis*, *Gutierrezia sarothrae*, 10 April 1978, *Morr 101* (NMC). *Luna Co.*: ca. 11 mi NW of Florida Station, among rocks in bed of dry creek, 29 Apr 1947, *McVaugh 8128* (SMU, TEX).

Collections examined. **MEXICO. Chihuahua.** Extreme NW corner [of the state], about 50 m E and 1.5 mi. S of U.S. border, in silty, heavily overgrazed bottom of draw, with *Yucca elata*, *Sporobolus airoides*, *Astragalus woottonii*, 13 May 1980, *Spellenberg & Ward 5525* (NMC). **Sonora.** 6.7 mi by road (Mexico 15) N of Magdalena, rocky hills, desert shrubs, 7 Apr 1968, *Felger 17451* (ARIZ); vicinity of Cerro Pelon, ca. 5 mi SE of Desemboque, 21 Apr 1968, *Felger 17894* (ARIZ); near El Guayabo on road 18 km E of Alamos. 27° 0' 20" N, 108° 47' 10" W, 250 m, 16 Mar 1989, *Ferguson s.n.* (ARIZ); along Hwy 89, 9.2 mi S of Arroyo Los Ajos, 7.4 mi N of Mututucachi, roadside in oak savanna, 212 Apr 1995, *Fishbein 2242* (ARIZ); Rio Mayo, San Bernardo, arroyo, Lower Sonoran, margin of a wash, 22 Feb 1935, *Gentry 1339* (ARIZ); Carbó, 50 km N of Hermosillo, wash near Mex Hwy 15, 6 Apr 1975, *Helmkamp s.n.* (UCR); Rancho El Aguilar Noria, N of Ures and Santiago, 29° 33' N, 110° 25-26' W, open, broad drainage, Sonoran desert scrub, on mesic N slopes, ca. 500 m, common, 21 Apr 1991, *Joyal 1995* (TEX); Dto. de Altar, Picu Pass, 23 Mar 1926, *Long 7a* (ARIZ); 18.7 mi W of Rte 19, along turnout 3.2 mi N of Esqueda, oak grassland, mesquite bottomlands, 27 Mar 1970, *McGill 64048* (ASU); 4.6 mi S of Cucurpe, cliff-face along San Miguel River and road, 29 Mar 1970, *McGill & Pinkava 6519* (ASU); Near El Guayabo on road 18 km E of Alamos, 250 m, 16 Mar 1989, *Martin & Ferguson s.n.* (ARIZ); Mpio. Soyopa, E side of Mex 16, 1 km S of Río Yaqui Bridge, 28° 31' 30" N 109° 32' W, 180 m, 14 Mar 1988, *Martin, Ferguson, & Moore s.n.* (NMC); NE side of Río Yaqui bridge on Mex 16, just S of Tonichi, 200 m, in sand, 18 Feb 1997, *Reina G. 97-44* (ARIZ); Arroyo La Quemana, near Tepoca, tropical decid. forest on slopes, rocky stream canyon, 560 m, 21 Mar 1998, *Reina G. 98-378* (ARIZ); Mpio. Benjamin Hill, 3.5 km SW of Benjamin Hill on road to Palo Alto, Sonoran desert scrub, 2408 ft, locally very common annual on disturbed rocky soil, 1 Jan 2003, *Reina G. 2003-286-A* (ASU); 0.8 km N of Mex 16 on road to San Antonio de la Huerta, 28° 34' 16" N, 109° 34' 52" W, very open thornscrub, 299 m, locally uncommon on flats, 15 Mar 2005, *Reina G. 2005-256* (TEX); Agua Prieta, Hwy 2, ca. 26 mi E of Agua Prieta and 24 mi W of the state line at Puerto San Luis, desert scrub of *Juniperus*, *Acacia*, *Prosopis*, *Yucca baccata*, *Gutierrezia*, etc. on rocky volcanic hills, 1300 meters, 19 Mar 1984, *Sanders 4712* (UCR); Alamos, Rio Mayo Region, Rancho La Huerta, ca. 2 mi NW of Alamos on the road to San Bernardo, north of the Alamos airstrip, weedy disturbed areas near buildings and roads, 420 meters, 15 Mar 1993, *Sanders 13152* (UCR); Alamos, Rio Mayo region, roadside c. 12 km W of Alamos on the road to Navojito, in vicinity of Cañon Agua Marina, at the foot of the Sierra de Alamos, burned roadside in hilly country 1640 ft, 15 Mar 1993, *Sanders 13180* (UCR); Alamos, Parque Chalaton and along canyon bottom above, SW edge of Alamos in foothills of the Sierra de Alamos, tropical deciduous forest and cleared areas, 420-450 meters, 17 Mar 1993, *Sanders 13365*

(UCR); Dist. Alamos, near Cerros, 4 Mar 1933, *Shreve 6167b* (ARIZ); 8 mi S of Estacion Llano, 3 Apr 1935, *Shreve 7323* (ARIZ); Palm Canyon, 17 mi SE of Magdalena, in Sierra Babiso, (= Cerro Cinta de Plata), stream bed, 13 Feb 1977, *Van Devender s.n.* (ARIZ); 4 mi of El Ocuca on Mex 2, 21.4 mi E of Altar, annual in wash, 10 Mar 1977, *Van Devender s.n.* (ARIZ); 17 mi SE of Magdalena on road to Cucurpe, Palm Canyon, Cerro Cinta de Plata, 15 May 1979, *Van Devender et al. s.n.* (ARIZ); Alamos, Rio Mayo region; Arroyo Mentidero at the crossing of El Chinal Road, near Rio Cuchujaqui, 11.5 km (by air) S of Alamos, tropical deciduous forest, 240 meters, 10 Mar 1993, *Van Devender 93-97* (ARIZ, UCR); Alamos, Rio Mayo region; La Huerta, 1.8 km NNE of Alamos on San Bernardo Road, 410 meters, 9 Mar 1993, *Van Devender 93-216* (ARIZ, UCR); La Huerta, 1.8 km NNE of Alamos on San Bernardo Road, common annual in yard, 410 meters, 9 Mar 1993, *Van Devender 93-216* (ASU); 0.4 mi E of Punto Cirio, Sierra Bacha, Sonoran Desert desert scrub, 40 m, 24 Mar 1995, *Van Devender 95-210* (ARIZ, UCR); El Llano de Curea, foothills thornscrub, locally uncommon annual, 514 meters, 19 Mar 2004, *Van Devender 2004-161* (ASU); 2.2 km SE of Rancho Las Borregas headquarters on road to Nogales, SE tributary of Arroyo Planchas de Plata, sycamore-oak canyon, 1187 m, 22 Apr 2004, *Van Devender 2004-2504* (ARIZ); 7.9 mi N of Esqueda, 11 May 1948, *Wiggins 11777* (TEX).

2. ***Spermolepis echinata*** (Nutt. ex DC.) A. Heller, Contr. Herb. Frankl. & Marsh. Coll. 1: 73. 1895. *Leptocaulis echinata* Nutt. ex DC., Prodr. 4: 107. 1830. *Apium echinatum* (Nutt. ex DC.) Benth. & J.D. Hook. ex S. Wats., Bibl. Index N. Amer. Bot., 412. 1878. TYPE: USA. Arkansas. "In Amer. bor. ad Red River" [protologue], *T. Nuttall s.n.* (holotype: BM digital image!; isotype: PH digital image!).

De Candolle noted ("v s.") that he had seen the Nuttall collection

Stems 5–40 cm. Leaves: blades broadly ovate in outline, 0.7–2.5 cm, 3-pinnately compound, ultimate divisions filiform, 2–18 mm x 0.5–1 mm; petioles 3–20 mm. Peduncles (1)–2–5(–6.5) cm. Umbels axillary mostly at distal nodes, all pedunculate; involucre bractlets 1–3(–4), linear, 1–3 mm, margins scabrous-toothed; fruiting rays 5–9(–12), (0)1–15 mm (central umbellet sessile to subsessile), unequal, suberect and evidently clustered; umbellets (1)–3–9-flowered; fruiting pedicels 1–6(–7) mm (central flowers short-pedicellate). Schizocarps 1.5–2 mm, densely echinate-bristly.  $2n = 20$  (Constance et al. 1976; Prairie Co., Arkansas, *Demaree 61921*, duplicate SMU!). Figure 8.

Flowering (Mar–)Apr–May(–Jun). Sand, gravel, silt, sandy clay, sandy roadsides and flats, disturbed areas, ditches, disturbed sites, pastures, rocky slopes, shell banks, sandstone outcrops, beaches, creek bottoms, lake shores, prairies, post oak woods, live oak woods, oak-mesquite woodland, desert shrub; (0–)100–300(–1500) m; Ala., Ark., Fla., Ga., Ill., Iowa, Kans., Ky., La., Miss., Mo., N.Y., N.C., Okla., S.C., Tenn., Tex., Va.; Mexico (Coahuila, Tamaulipas).

Specimen examined. MEXICO. Coahuila. Piedras Negras, *Pringle 8309* (fide Villarreal 2001, voucher not seen in present study). Tamaulipas. 20 mi W of Reynosa, desert scrub in clayish soil, 28 Feb 1944, *Pamter & Barkley 14378* (TEX).

Attributions of *Spermolepis echinata* to Arizona, California, and New Mexico have been based on collections identified here as *S. lateriflora*. In Texas, typical *S. echinata* reaches as far west as Brewster, Culberson, Jeff Davis, Pecos, and Presidio counties, but it does not extend to El Paso Co. at the easternmost extension of the distribution of *S. lateriflora*. No confirmed records of *S. echinata* exist from New Mexico.

A plant collected in north-central Texas has the habit and inflorescence of *Spermolepis echinata* and echinata-like fruits (densely tuberculate-hairy) but with the hairs relatively short and without an uncinat apex. Wilbarger Co.: 14.5 mi W of Electra, Waggoner pastures, turn W 0.6 mi S on Hwy 85, tall grass in draw, mesquite savanna, sandy loam, 12 May 1945, *Whitehouse 9828* (SMU).

3. *Spermolepis hawaiiensis* H. Wolff, Repert. Spec. Nov. Regni Veg. 17: 440. 1921. TYPE: USA. Hawaii. Kauai, Weimea, [no date], *Hillebrand s.n.* (holotype: probably B, Wolff material at B mostly extant fide HUH online database). EPITYPE (designated here): USA. Hawaii. Kauai Co. (Kauai Island): Koai'e Canyon, just below "the fingers" near the ridge and above N-facing cliffs W of Lonomoa Camp and Kawai'iki and E of Hipalau, 704 meters, 21 Apr 2004, *N. Tangalin 47* (PTBG 043006, digital image on JSTOR!; Fig. 9). This collection was made near the type locality.

Stems 5–20 cm. Leaves: blades oblong to ovate in outline, 1–4 cm, 3-pinnately compound, becoming sessile, smaller, and less divided distally, ultimate divisions linear to linear-lanceolate, 3–6 mm; petioles 10–30 mm. Peduncles 1–3 cm. Umbels at distal nodes, axillary, all pedunculate; involucre bracts absent; involucre bractlets (0–)1–5, linear-lanceolate, 1–6 mm; fruiting rays 2–7, (0–)5–15 mm (central umbellets sessile to short-pedicellate), unequal, spreading-ascending; umbellets 2–8-flowered; fruiting pedicels (0–)2–6 mm (central flower sessile to short-pedicellate), unequal, spreading-ascending to ascending. Schizocarps 3–4 mm, densely echinate-bristly, hairs arising from multicellular tuberculate bases.  $2n = 22$  (Wagner et al. 2005). Figure 9.

Flowering (Dec, Feb–)Mar–Apr. Steep mesic forests, gulch slopes and ridge tops in dry forest, shrub lands, steep to vertical cliffs, cliffs bases, ridges in coastal dry cliff vegetation, N-facing slopes, ridges on bare rock, open, rocky, goat-ravaged area, a'a lava; 50–700 m; endemic to the Hawaiian Islands — Hawaii, Kauai, Lanai, Maui, Molokai, Oahu. Information from NTBG (2012) and USFWS (2010).

4. *Spermolepis infernensis* G.L. Nesom, sp. nov. TYPE: USA. California. San Diego Co.: Hell Hole Canyon near Borego, 5–7 Apr 1932, *C. Epling & W. Robison s.n.* (holotype: RSA!; isotype: UC! digital image!).

Similar to *Spermolepis lateriflora* in its epedunculate (sessile) umbels but different in its sparse fruit vestiture of apically straight, blunt-tipped hairs.

Stems 7–13 cm, branching from the base. Leaves: blades broadly ovate in outline, mostly 1–2 cm, finely ternately dissected, ultimate divisions linear to oblong, mostly 2–6 mm; petioles 10–20 mm. Peduncles usually absent, occasionally present and 2–3.5 cm. Umbels axillary, sessile at distal nodes, sometimes pedunculate at proximal nodes; involucre bracts absent; involucre bractlets (1–)2–4, linear, 1–4 mm, margins entire, herbaceous, without scarious margins; fruiting rays 4–5 per node, (0–)3–10 mm (inner umbellets sessile or subsessile to short-pedicellate), unequal, spreading; umbellets (2–)4–7 flowered; fruiting pedicels 1–5.5 mm (inner flowers short-pedicellate). Schizocarps 1.5–2 mm, ribs rounded, sparsely to moderately tuberculate to hispidulous-spinulose on the angles and intervals with pustulate multicellular mounds, each pustular mound with a straight, erect, blunt-tipped, unicellular, hairlike cell, 0.1–0.2 mm or some mounds without a hair, lateral ribs not strongly differentiated; oil tubes 3 per interval, barely evident between the thickened ribs. Chromosome number not reported. Map 5. Figures 10, 11.

Flowering Mar–Apr. Desert shrubland; 600–700 m; California (San Diego Co.).

In deriving the concept and description of *Spermolepis infernensis*, I have seen only the two sheets of the type collection, which include 9 separate plants of consistent morphology. The type collection is from the area of the Hellhole Canyon Preserve, which is northeast of Escondido at elevations of about 1800–2000 feet elevation. The reference by Epling and Robison to "Borego" apparently meant Borrego, since Hellhole Canyon is in the general vicinity of the Borrego Valley and the Anza-Borrego Desert State Wilderness Park (see comments above in connection with *S. lateriflora*).



*Spermolepis infernensis* and *S. lateriflora* perhaps are sister species, in view of their similarity in inflorescence structure and distribution in the western USA. It is possible that *S. infernensis* is a recent derivative of *S. lateriflora*, with a reduction in the density of the fruit vestiture and a developmental change that results in truncation of the hairs. The difference in appearance is striking, however, and the effect on dispersal potential surely must be significant.

5. *Spermolepis inermis* (Nutt. ex DC.) Mathias & Constance, Bull. Torrey Bot. Club 68: 124. 1941. *Leptocaulis inermis* Nutt. ex DC., Coll. Mém. 5: 39, plate 10, fig. B. 1829. *Spermolepis patens* var. *inermis* (Nutt. ex DC.) Mathias, Brittonia 2: 243. 1936. TYPE: USA. Arkansas. "In Amer. bor. ad Red River" [protologue], *T. Nuttall s.n.* (holotype: BM digital image!; isotype: PH digital image!).

De Candolle noted ("v.s.") that he had seen the Nuttall collection  
*Leptocaulis patens* Nutt. ex DC., Prodr. 4: 107. 1830. *Apium patens* (Nutt. ex DC.) S. Wats., Bibl. Index N. Amer. Bot., 413. 1878. *Apiastrum patens* (Nutt. ex DC.) Coulter & Rose, Rev. N. Amer. Umbell., 110. 1888. *Spermolepis patens* (Nutt. ex DC.) B.L. Robins., Rhodora 10: 34. 1908. TYPE: USA. Arkansas. "In Amer. bor. ad Red River" [protologue], *T. Nuttall s.n.* (holotype: BM digital image!; isotypes: NY digital image!, PH digital image!).

De Candolle noted ("v.s.") that he had seen the Nuttall collection

Stems 8–80 cm. Leaves: blades oblong-ovate in outline, 3–5 cm, 3-pinnately compound, ultimate divisions filiform, 3–30 mm x 0.1–1 mm; petioles 4–15 mm. Peduncles 2–7 cm. Umbels terminal and axillary, all pedunculate; involucre bracts absent; involucre bractlets 1–4, linear to linear-lanceolate, 2–5 mm, margins scabrous-toothed; fruiting rays 5–11, suberect and evidently clustered, unequal, 1–13 mm (central umbellet subsessile); umbellets 2–7-flowered; fruiting pedicels (0–)1–6 mm (central flower sessile to short-pedicellate). Schizocarps 1.2–2 mm, tuberculate, without trichomes; oil tubes 1 per dorsal interval. Chromosome number not known (reported in error as  $2n = 22$  by Bell & Constance 1957; voucher from Florida identified here as *S. divaricata*). Map 3. Figure 13.

Flowering Apr–May(–Jun). Sand, river silt, gravelly soil, clay loam, sand prairies, blackland prairies, shale glades and barrens, rocky ridges, granite outcrops, limestone crevices, oak-juniper woodland, ditch banks, woods edges, roadsides, fields; 30–200(–900) m; Ala., Ark., Ill., Ind., Iowa, Kans., La., Md., Minn., Miss., Mo., Nebr., N.Mex., Okla., Tenn., Tex.; Mexico (Coahuila).

East of the Mississippi River in the southeastern USA, *Spermolepis inermis* occurs only in widely disjoint localities in Mississippi, Alabama, and Tennessee; in Louisiana and Alabama, the scattered populations occur mostly in prairie patches. Bonafide records seen in the present study are documented here. Mississippi. Monroe Co.: ca. 3 mi SSW of Prairie along Hwy 25, 2.4 mi S of jet with Hwy 382, 7 May 1996, McDonald 9364 (VDB); ca. 1.5 mi SW of Aberdeen, remnant prairie roadside at jct state hwy 25 and 382, 23 May 1996, McDonald 9466 (BAYLU). Oktibbeha Co.: Botanic Garden of the South, ca. 1.5 mi S of Sessums on Sessums Rd, Black Prairie region, 21 May 1997, Leidolf 1512 (VDB). Alabama. Sumter Co.: Blackland prairie between Gainesville and Alabama 17, 20 May 1975, Kral 55614 (VDB). Tennessee. Warren Co.: 1 mi NE of Morrison, ballast of railroad adjacent swamp and Hwy 55, 18 May 1987, Patrick & Wofford 2029 (SMU).

*Spermolepis inermis* probably is not native in Maryland, where it has been reported (Brown & Brown 1984). Radford et al. (1968) noted its occurrence in New Hanover Co., North Carolina, but no voucher exists in the NCU herbarium (Alan Weakley, pers. comm.). Some Alabama collections at VDB previously identified as *S. inermis* are instead *S. divaricata* (Baldwin Co., Lelong 7712; Dallas Co., Sessler 1178; Geneva Co., Kral 90807), and this mistaken identity probably also has been the case for the Maryland and North Carolina reports.

Additional specimens examined (outlying populations). USA. New Mexico. Eddy Co.: Carlsbad Caverns Natl. Park, 1.8 mi WSW of E boundary via sewage lagoon road, 0.7 mi E of sewage lagoons, small arroyo lined with shrubs, on bajada escarpment, 3650 ft, 19 Apr 1977, *Burgess 4496* (TEX); Carlsbad Caverns Natl. Park, Walnut Canyon, ca. 0.2 mi S, 0.2 mi W of BM 3901, gravel alluvium dominated by *Brickellia laciniata*, 17 May 1977, *Burgess 4556* (ARIZ, TEX). MEXICO. Coahuila. Rio Grande, Tule Canyon, on Coahuila side above Upper Madison Falls, calcareous gravelly soil, *Dasyllirion*, *Yucca*, *Nolina*, *Rhus*, *Acacia*, 475 m, 10 Apr 1973, *Johnston et al. 10615* (LL); San Rosendo Canyon (flows into Rio Grande opposite Brewster Co.), 500–700 m, calcareous gravelly loam, *Dasyllirion*, *Yucca*, *Nolina*, *Larrea*, *Acacia*, *Quercus*, *Prosopis*, 9 Apr 1973, *Johnston et al. 10597B* (LL); Musquiz, spring 1935, *Marsh 113* (TEX); Sierra de Santa Rosa, Canon El Puerto, Rancho El Puerto, 28 24 N, 101 54 W, matorral de *Acacia coulteri*, *Pithecellobium pallens*, *Zanthoxylum fagara*, *Yucca thompsoniana*, y *Opuntia lindheimeri*, 900–1000 m, 6 Jun 1991, *Villarreal 5963* (BRIT); Mpio. Musquiz, Hacienda La Rosita, 26 Jun 1936, *Wynd & Mueller 295* (ARIZ).

Fruits of a collection from south-central Texas, identifiable as *Spermolepis inermis* in every other way, have some tubercles producing very short, blunt-tipped hairs, similar to those of *S. organensis* and *S. infernensis*. Wilson Co.: 8 mi S of Elmendorf, 4 May 1945, *Cory 48793* (SMU).

*Spermolepis inermis*, *S. divaricata*, *S. diffusa*, *S. laevis*, and *S. organensis* appear to be closely related among themselves. If the ancestral species of *Spermolepis* had hairy fruits with (e.g., *S. echinata*, *S. gigantea*), then *S. inermis* can be understood as derived through loss of the hairs. *Spermolepis laevis* probably is a derivative of *S. inermis*, through further loss of the surface ornamentation of the fruits. *Spermolepis divaricata* and *S. diffusa* perhaps are sister species, through reduction of the inflorescence from an ancestor shared with *S. inermis* (maintaining the potential to produce fruit hairs). *Spermolepis organensis* is possibly a peripheral isolate of *S. inermis*; its short, stubby fruit hairs are like those of *S. infernensis* and rare populational forms of *S. inermis*, perhaps through partial derepression of the hair formation.

6. *Spermolepis laevis* G.L. Nesom, sp. nov. TYPE: USA. Texas. Llano Co.: Enchanted Rock, granitic sandy soil, 15 May 1933, *E. Whitehouse 11292* (holotype: SMU)

Similar to *Spermolepis inermis* in general appearance, especially its strictly pedunculate, terminal and axillary umbels and its relatively short, suberect and evidently clustered fruiting rays; different in its completely smooth fruit surface, with evident ribs but lacking tubercles on the ribs or intervals.

**Stems** 8–48 cm. **Leaves**: blades ovate to broadly ovate in outline, 1–4 cm, 3-pinnately compound, ultimate divisions filiform, 4–15(–25) mm; petioles 2–15 mm. **Peduncles** 2–5 cm. **Umbels** terminal and axillary, all pedunculate; involucre bracts 0 or very rarely 1–2; involucel bractlets 1–4, linear to linear-oblong or linear-lanceolate, 1–3(–5) mm, margins scabrous-toothed; fruiting rays 3–8, suberect and evidently clustered, unequal, (0)–2–9(–13) mm (central umbellet sessile to subsessile); umbellets (1)–3–8-flowered; fruiting pedicels (0)–3–5 mm (central flowers sessile to subsessile). **Schizocarps** 1–1.2 mm, minutely beaked, surface smooth, dorsal ribs 3, oil tubes 1 per dorsal interval. **Chromosome number** not reported. Map 3, Figure 14.

Flowering Apr–May(–Jun). Granite outcrops, granitic gravel, limestone gravel, sandy fields, oak-cedar slopes, live oak savannas; 200–500 m; Okla., Tex.

Additional collections examined. **Oklahoma**. Johnston Co.: 10 mi N of Tishomingo, near Wapanucka Road jct, grazed prairie along State Hwy 99, sandy granitic soil from nearby granite knobs, 29 May 1948 [fruit], *Robbins 3064* (UC). **Texas**. Bell Co.: nature prairie near Little River, 5

Jun 1930, *Wolff 2201* (VDB); near Little River, field, 11 May 1930, *Wolff 2102* (BRIT); Temple, from around Substation #5, 11 May 1930, *Wolff 2102* (SMU, perhaps duplicate of the BRIT sheet of same number). **Burnet Co.:** Granite 'hills' [?], sandy soil, 29 May 1922, *Tharp s.n.* (TEX); near Burnet, sandy soil, 26 Apr 1931, *Whitehouse 11291* (SMU); Inks Lake State Park, ca. 1 mi S of Hwy 29, granite outcrop, 1 May 1947, *Whitehouse 18439* (SMU). **Gillespie Co.:** ca. 12 mi N of Fredericksburg, dry soil on oak-cedar slope, 29 Jun 1957, *Correll & Johnston 17269* (LL). **Hamilton Co.:** [no other locality data], 12 Jun 1941, *Tharp s.n.* (TEX). **Llano Co.:** [no other locality data], 11 Jun 1930, *Tharp s.n.* (TEX). **Mason Co.:** Mason Mountain Wildlife Management Area, in Middle Pasture, 0.2 mi N of Mile-O-More Lake, 23 Apr 2001, *Sanchez 2355* (BAYLU); MMWMA, in Middle Pasture, near the Lodge, near Una Branta Lake, 19 Apr 2003, *Sanchez 3224* (BAYLU); MMWMA, in West Pasture, downstream from Comanche Lake, near the Beaver Dam, sandy soil, 15 Apr 2005, *Sanchez 3697* (BAYLU); Mason Mountain Wildlife Management Area, in Middle Pasture, 0.9 mi NE of gate into Headquarters Pasture, sandy soil, 29 May 2005, *Sanchez 3879* (BAYLU, BRIT); MMWMA, in Middle Pasture, 0.3 mi NE of Headquarters Bldg., live oak savanna, sandy soil, 17 May 2008, *Hansen 5922* (BAYLU, TEX); granite outcrops on S side of RM 1222, 2.6 km E from intersection of US Hwy 87 and RM 1222 at Camp Air, frequent in dry crevice, 17 May 1979, *Walters 301* (SMU). **Tarrant Co.:** near Fort Worth, in old field, 15 Jul 1924, *Ruth 1107* (SMU); gravel road N of Crowley under Santa Fe bridge, limestone gravel soil, Grand Prairie, 21 Apr 1946, *Whitehouse 15491* (SMU).

The Oklahoma collection (Johnston Co.) consists of 5 plants — 3 are typical *Spermolepis echinata* but 2 are typical *S. laevis*, the fruits completely glabrous.

From Bell Co., Texas, *Wolff 2201* has perfectly smooth fruits; fruits of *Wolff 2102* (Fig. 1o) are very slightly tuberculate but better identified as *Spermolepis laevis* than *S. inermis*; *Wolff 657* (BRIT) from Bell Co., however, is clearly *S. inermis*. Both taxa have been collected in Bell, Burnet, Gillespie, and Tarrant counties. Field study toward a better understanding of the distribution of *Spermolepis laevis* and its biology, especially its possible interaction with *S. inermis*, will be interesting and useful.

7. *Spermolepis organensis* G.L. Nesom, sp. nov. TYPE: USA. New Mexico. Dona Ana Co.: Organ Mts., Rock Springs Canyon, NWNW Sec 34, T22S, R4E, common on gravelly loamy granitic soil on 5 deg N-facing slope, with *Quercus arizonicus*, *Juniperus deppeana*, *Garrya wrightii*, *Cercocarpus montanus*, *Rhus trilobata*, 5400 ft, 6 Jun 1995, *L. McIntosh 3106* (holotype: NMC!).

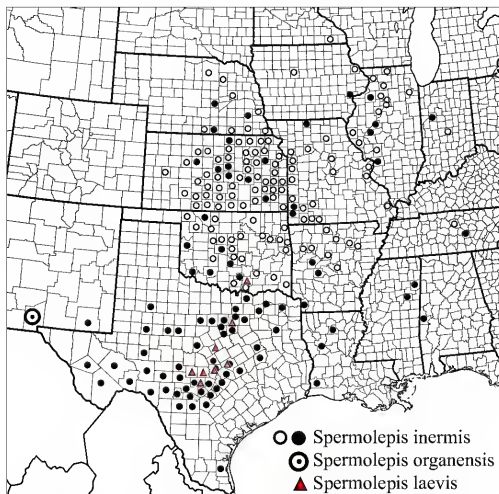
Similar to *Spermolepis inermis* in its strictly pedunculate, terminal and axillary umbels; different in its shorter fruiting peduncles and in its corky fruit surface with vaguely formed tubercles, some tubercles producing short, straight hairs, some without hairs.

Stems ca. 20 cm, purple. Leaves: blades broadly ovate in outline, 1.5–2 cm, 2–3 ternately compound, ultimate divisions filiform, 4–11 x 0.1 mm; petioles 2–8 mm. Peduncles 0.9–3.5 cm. Umbels terminal and axillary, all pedunculate, indeterminate; involucre bracts absent; involucre bractlets 1–4, margins smooth, 1–3 mm; fruiting rays 4–7, suberect and clustered, unequal, (0–)4–10 mm (central umbellet sessile); umbellets (3–)4–6-flowered, fruiting pedicels (0.2–)1–4 mm (central flowers sessile to subsessile). Schizocarps 1.2–1.5 mm, dorsal ribs 3, rounded, often somewhat obscured by the corky epidermis, lateral ribs similar to dorsal, oil tubes 1 per dorsal interval; surface with vaguely formed multicellular tubercles and/or rounded lateral ridges, tubercles sometimes with a straight, erect, blunt-tipped unicellular hairlike cell. Chromosome number not reported. Map 3. Figure 12.

Flowering May–Jun. Granitic gravelly loam, oak-juniper slopes, 1800 m, N Mex., known only from the type collection.

The distinctive features of *Spermolepis organensis* might be interpreted as derived from those of *S. inermis*. The peripheral geographic location of *S. organensis* (Map 3) also suggests that this might be true but other outlying populations of *S. inermis* exist. Recognition of *S. organensis* as a species, albeit it weakly defined, emphasizes the apparent, at least partial derepression of the fruit hair formation, the corky fruit surfaces, and the relatively short fruiting peduncles.

If *S. organensis* were interpreted as of hybrid origin from extant parents, the only other species of *Spermolepis* currently known from the Organ Mountains is *S. lateriflora*. The nearest known occurrence of *S. inermis* is to the east in Eddy Co., that also somewhat of a geographic isolate.



Map 3. Distribution of *Spermolepis inermis*, *S. laevis*, and *S. organensis*. Open symbols are from literature and various sources, vouchers seen for others outside of Texas but not recorded.

**8. *Spermolepis divaricata*** (Walt.) Raf., Bull. Bot., Genève 1: 217. 1830. *Daucus divaricatus* Walt., Fl. Carol., 114. 1788. *Ammi divaricatum* (Walt.) Pers., Syn. Pl. 1: 308. 1805. *Aethusa divaricata* (Walt.) Spreng., Pl. Umbell. Prodr., 22. 1813. *Sison divaricatum* (Walt.) Spreng., Sp. Umbell., 113. 1818. *Leptocaulis divaricatus* (Walt.) DC., Coll. Mem. 5: 39. 1829. *Babiron divaricatum* (Walt.) Raf., New Fl. 4: 24. 1836. *Apium divaricatum* (Walt.) A.W. Wood, Amer. Bot. Fl., 140. 1870. **NEOTYPE** (Ward 2008, p. 475): **USA. South Carolina.** Charleston Co.: Wadmalaw Island, S of Charleston, 27 May 1988, D. Boufford & E. Wood 23862 (GH; isoneotypes: MO, NY).

Walter did not cite a specimen or locality, Ward (2008) noted that "Spm 40-C, a wispy fragment, was labeled "Daucus" by Fraser, and annotated as "divaricatus Walt." by A. Gray, though one wonders what he saw that was recognizable."

*Sison pusillum* Michx., Fl. Bor.-Amer. 1: 168. 1803. *Ligusticum pusillum* (Michx.) Pers., Syn. Pl. 1: 315. 1805. **TYPE: USA.** [protologue] "In sabulosis aridis Carolinae," *A. Michaux?* (holotype: P?).

*Babiron dichotomum* Raf., New Fl. 4: 24. 1838. **TYPE: USA. Florida.** Rafinesque did not cite a specimen, noting only "Florida." As synonym of *S. divaricata* fide Mathias and Constance (1944).

*Babiron pusillum* Raf., New Fl. 4: 23. 1838. **TYPE: USA. Alabama or Georgia.** Rafinesque noted "sent me from Alabama, and by Dr. Torrey from Georgia as the *Daucus pusillus*! see 788." As synonym of *S. divaricata* fide Mathias and Constance (1944).

**Stems** 7–40 cm. **Leaves:** blades oblong to oblong-ovate in outline, 0.5–5 cm, 3-pinnately compound, ultimate divisions linear, 3–10(–15) x 0.2–1 mm; petioles 1–30 mm. **Peduncles** 17–40(–50) mm. **Umbels** terminal and axillary, all pedunculate; involucre bracts absent; involucre bractlets 1–3, narrowly lanceolate, 0.5–1 mm, the margins usually callous-toothed; rays 3–6, divaricately spreading, unequal, 5–17 mm; umbellets (3–)4–6-flowered; fruiting pedicels (0–)2–9 mm (central 1–2 flowers subsessile to sessile). **Schizocarps** 1.5–2 mm, scarious with minute, upcurved hairs not arising from a tuberculate base. **Chromosome number:** see comments below. Map 4. Figure 15.

**Flowering** Mar–Apr(–May). Sandy woodlands (longleaf pine-turkey oak, pine-oak, oak scrub, flatwoods, evergreen scrub oak), prairie remnants, sandy peat, sandy roadsides, fields, pastures, and clearings, lawns, abandoned gardens, orange groves, moist ditches, swamp and salt marsh edges, shell mounds, sand ridges, sandhills, sand prairies, sandy peat of bogs; 0–200 m; Ala., Fla., Ga., La., Miss., N.J., N.C., S.C., Tex., Va.

Confusion exists regarding chromosome numbers of *Spermolepis divaricata*, *S. inermis*, and *S. echinata*. Numbers of  $2n = 22$  and  $2n = 16$  apparently both are based on vouchers both identified as *S. divaricata*. Vouchers for both counts were collected in Florida, so at least it is clear that neither could have been the basis of a count for *S. inermis*. The count of  $2n = 20$  for *S. echinata* was made from an Arkansas plant (see description of *S. echinata*) securely identified as that species. While it seems unlikely that *S. divaricata* has two such distinct dysploid numbers, the possibility opens an interesting evolutionary study.

**$2n = 22$**  (Bell & Constance 1957; **Florida.** Okaloosa Co.: roadside banks just E of bridge 3.6 mi W of Crestview, 17 Apr 1954, *Bell 1470*, NCU [fide A. Weakley], VDB!, "Voucher for chromosome count of  $n = 11$ " on specimen). Initially identified by Bell as *Spermolepis divaricata*; annotated as *S. inermis* by Mathias & Constance and reported in publication as *S. inermis* with  $n = 11$ ; later annotated by H.E. Ahles and by Alan Weakley as *S. divaricata*; confirmed by Weakley (pers. comm.) as *S. divaricata*.

**$2n = 16$**  (Bell & Constance 1957; **Florida.** Escambia Co.: sandy roadside along Fla. Hwy 297, 5 Apr 1955, *Bell 1514*, NCU [fide A. Weakley], "Voucher for chromosome count of  $n = 8$ " on specimen).

Initially identified by Bell as *Spermolepis echinata* and reported in publication as *S. echinata* with  $n = 8$  in the Bell and Constance publication. Specimen later annotated by Mathias & Constance and by Alan Weakley as *S. divaricata*; confirmed by Weakley, pers. comm., as *S. divaricata*.

Attributions of the species to New Mexico have been based on misidentifications of *Cyclospermum leptophyllum*. PLANTS Database attributes *Spermolepis divaricata* to New Jersey, based on an unpublished "Chrysler Herbarium Checklist" (Rutgers University) by J. Meyer from 1990. The voucher, correctly identified in the checklist, is this: New Jersey. [Camden Co.]: Camden, ballast, 26 Jun 1866, *C.F. Parker s.n.* (CHRB digital image!). The species is regarded here as a waif in New Jersey and not a permanent member of the state flora.

The plants of *Spermolepis divaricata* from Acadia Parish, Louisiana, from prairie remnants along a railroad right-of-way, have pedicels in the upper range of length (mostly 5–9 mm) for the species but the central flowers of each umbellet are subsessile and fertile. Acadia Par.: along RR ca. 3.5 mi SW of Crowley, 7 May 1966, *Lemmon 1168* (LSU digital image!).

Two collections of *Spermolepis divaricata* are recorded here for Texas. Austin Co.: Industry, 1895, *Mr. H. Wurzlów s.n.* (BRIT). Liberty Co.: along Co. Rd 2252 W of the Davis Hill Baptist Church and N of Hwy 105 E of Cleveland, 26 Apr 1997, *Brown 20285* [without fully mature fruits but the pedicels are short and the umbellets have sessile central flowers with evidently maturing fruits] (NLU).

The difference between *Spermolepis divaricata* and *S. inermis* can be subtle but is nevertheless real. Before full fruit maturation, outgrowths of the ovary surface of *S. divaricata* can look like developing tubercles of *S. inermis* although they usually have an antorse orientation. This similarity perhaps was the basis for the Mathias & Constance annotation of *Bell 1470* (as *S. inermis*; see comments above about chromosome numbers), which has short hairs and some tuberculate bases without hairs. In *S. inermis*, the central rays are consistently very short and there is a relatively small angle of divergence, overall giving the umbels a congested appearance. In *S. divaricata*, the rays (including the central) mostly are equal to subequal in length and diverge at a relatively greater angle, giving the umbels a more open appearance.

*Spermolepis divaricata* and *S. diffusa* characteristically produce a determinate inflorescence – the axillary bud and terminal leaf are suppressed at the distalmost node (Fig. 2B). In some plants from Florida, however, this apparent specialization is not expressed (de-repressed?) and the pattern is determinate (Fig. 2A). These apparently are populational variants. Examples: Alachua Co.: *Dunn 525* (FLAS), *Kabat 488* (FLAS, 9 plants, 2 determinate, 9 indeterminate), *Scudder 1491* (FLAS). Baker Co.: *West & Arnold s.n.* (FLAS). Hernando Co.: *Nee et al. 2798* (FLAS). Highlands Co., *Baltzell 1799* (FLAS, 2 plants, 1 determinate, 1 indeterminate).

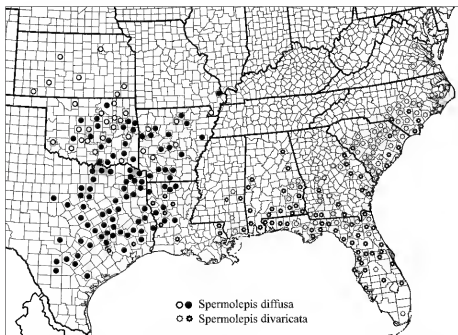
9. *Spermolepis diffusa* (Nutt. ex DC.) G.L. Nesom, **comb. nov.** *Leptocaulis diffusus* Nutt. ex DC., Prodr. 4: 107. 1830. LECTOTYPE (designated here): USA. Arkansas. "In Amer. bor. ad Red-River" [protologue], *T. Nuttall s.n.* (BM 001042884 digital image!; isolecotypes: BM 001042883 digital image!, NY digital image!, PH-2 sheets digital image!).

De Candolle noted ("v. s.") that he had seen the Nuttall collection

Stems 15–75 cm. Leaves: blades oblong to oblong-ovate in outline, 0.5–5 cm, 3-pinnately compound, ultimate divisions linear, 3–15 x 0.2–1 mm; petioles 1–30 mm. Peduncles 20–50 mm. Umbels terminal and axillary, all pedunculate; involucre bracts absent; involucre bractlets 1–3, linear-lanceolate, 0.5–1 mm; fruiting rays 2–4(–6), divaricately spreading, subequal, 15–33 mm; umbellets 2–4(–5)-flowered; fruiting pedicels (8–)14–32 mm (all flowers of each umbellet with subequal

pedicels, none sessile or subsessile) **Schizocarps** 1.5–2 mm, scabrous with minute, upcurved hairs not arising from a tuberculate base **Chromosome number** not reported Map 4 Figure 16

**Flowering** Apr–May(–Jun). Sandy clay, sand, roadsides, fencerows, fields, pastures, dunes and sandy hills, thin soil under oak-juniper, sandy soil in longleaf pine, pine, oak-pine, oak-hickory, post oak, and post oak-blackjack oak woods, lake shores, 50–500 m, Ark., Kans., La., Mo., Okla., Tex.



Map 4. Distribution of *Spermolepis diffusa* and *S. divaricata*. Completely hollow symbols are from literature and other sources, vouchers not seen in the present study

Aptly named *Leptocaulis diffusus* has long lain in synonymy of *Spermolepis divaricata* but its morphological distinction from typical *S. divaricata* is easy to discern. The long pedicels and rays of *S. diffusa* usually provide ID-at-a-glance, if the pedicels are in the shorter part of the range, the lack of sessile or subsessile flowers provides a second criterion. The range of *S. diffusa* is entirely west of the Mississippi River. The two species appear to be sympatric in central Louisiana and southeastern Texas. Vouchers documenting the occurrence of both species in Natchitoches and Vernon parishes (Louisiana) are at NLU.

Plants in a few scattered Texas collections have abnormally short pedicels: Anderson Co., pedicels 8–11 mm, *Bridges & Kindscher 13731* (BRIT, TEX), Comanche Co., pedicels 6–10 mm, *Shinners 20078* (SMU). In the Anderson Co. collection, a low percentage of the umbellets produced a single central, subsessile flower that did not develop a mature fruit. These plants are within the geographic range of *S. diffusa* and are regarded here as populational variants of that species, perhaps reflecting ancestral (*S. divaricata*-like) characteristics

The close similarity and probable sister relationship of *Spermolepis diffusa* to *S. divaricata* might be emphasized in treating the two as conspecific varieties. The course here emphasizes their distinction in morphology and geography (and by inference, ecology). Pointed field observations in their region of sympatry would be interesting, and a chromosome count for *S. diffusa* might provide evidence for an internal isolating mechanism, especially in view of the apparent lability in chromosome number within the genus.

- 10. *Spermolepis castellanii* Pérez-Mor., Lilloa 5: 32, fig. 1. 1940. LECTOTYPE (designated here): ARGENTINA. Prov. Río Negro. San Antonio Este, 21 Nov 1928, A. Castellanos (BA 28/1184). Pérez-Moreau cited three other collections — two from Neuquen (leg. Ragonese, Pérez-Moreau) and one from Mendoza (leg. Ruiz Leal).**

**Stems** ca. 4–8 cm tall, simple or few-branched mostly at nodes above the base. **Leaves:** blades broadly ovate in outline, 25–40 mm, ultimate divisions 4–8 mm, scaberulous on margins and nerves; petioles 7–10 mm, scarious-margined at base. **Peduncles** 20–50 mm. **Umbels** axillary, all pedunculate; involucre bracts absent or 1; involucre bractlets 3–4, linear-lanceolate, entire, 1.5–7 mm, unequal; fruiting rays 3–5, 1–15 mm (inner 1–2 umbellets short-pedicellate), spreading; umbellets 3–5-flowered; fruiting pedicels (1–)7–9 mm (inner flower short-pedicellate), loosely convex to irregular. **Schizocarps** oblong-ellipsoid, attenuate toward the apex, 3.2–5.3 mm, hispid-hirsutulous on the angles and intervals with narrowly triangular, straight, blunt-tipped hairs, dorsal ribs 3, rounded, lateral ribs not expanded; oil tubes 1 (rarely 2–3) per interval, 2 on the commissural face.  $2n = 64$  (Constance et al. 1976; Hunziker 12523, Córdoba, Argentina). Figure 17.

*Spermolepis castellanii* apparently is endemic to west-central Argentina. Pérez-Moreau (1940) cited collections from the provinces of Río Negro, Neuquen, and Mendoza. The hexaploid chromosome count by Constance et al. (1976) was from Prov. Córdoba. Photos on Flickr by Joseph Fourier (2009) are from Prov. San Luis.

- 11. *Spermolepis gigantea* (Coulter & Rose) G.L. Nesom, comb. nov. *Ammoselinum giganteum* Coulter & Rose, Contr. U.S. Natl. Herb. 7: 89. 1900. TYPE: USA. Arizona. Maricopa Co.: mesas near Phoenix, 17 Jun 1882, C.G. Pringle 28 (holotype: GH; isotypes: fragment JEPS digital image!, NY digital image!, US digital image!).**

*Ammoselinum occidentale* Munz & Johnston, Bull. Torrey Bot. Club 52: 224. 1925. TYPE: USA. California. Riverside Co.: "Hayfields" [Hayfield pumping plant locality], Chuckwalla Valley, Colorado Desert, locally abundant in heavy soil of a dry basin under shrubs and in the open, 500 ft, 13 Apr 1922, P.A. Munz & D.D. Keck 4930 (holotype: POM digital image!; isotypes: BM digital image!, JEPS!, UC!).

**Stems** 8–26 cm, simple or branching from the base. **Leaves:** blades obovate to broadly ovate in outline, 12–25 mm, ultimate divisions linear, (1–)4–13 mm; petioles 3–25(3–0) mm. **Peduncles** 2–5.5 cm or penultimate umbel sometimes sessile (see NY isotype, Fig. 19). **Umbels** terminal and axillary; fruiting rays 4–10, (0–)2–22 mm (inner umbellet sessile), unequal, spreading; umbellets 1–10 flowered; pedicels (0–)2–8 mm (inner flower sessile to subsessile); involucre bracts (0–)1–3, linear or sometimes 3-fid; involucre bractlets 1–6, linear to linear-lanceolate, entire or less commonly 2–3-fid, 2–12 mm, sometimes scarious-margined at base. **Schizocarps** narrowly elliptic-ovate to urceolate-oblong or ovoid-oblong, 3–4 mm, ribs low-rounded, hispid-hirsutulous on the ribs and intervals with sharp-pointed, 1–2-celled hairs arising from a conical, non-pustulate base, dorsal ribs 3, cordlike and thickened, lateral ribs flattened and broad, nearly obscuring the commissural sulca; dorsal oil tubes 3 per interval, commissural oil tubes 2.  $2n = 38$  (from label of McKay 64: " $n = 19$  Chromosome vouchers cultivated in University of California Botanical Garden, C-775"). Map 5. Figures 18, 19, 20.

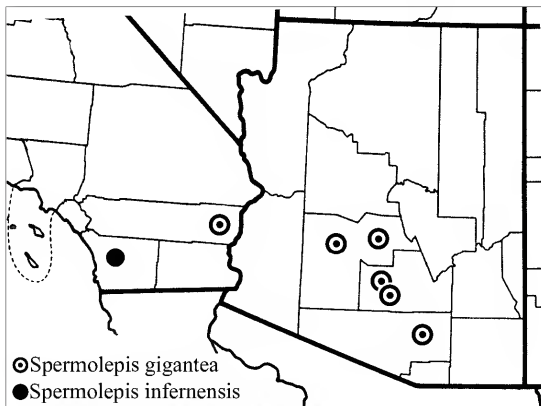


Flowering Mar–Apr Roadsides, sandy flats, desert shrubland with *Larrea*, 200–800 m, Ariz., Calif.

*Spermolepis gigantea* is rare and represented in Arizona only by the collections cited here from Maricopa, Pima, and Pinal counties; in California it is known only from the type of *Ammoselinum occidentale*, collected in eastern Riverside County (Map 4). Wolff (1927) and Mathias and Constance (1945) identified *Pringle* 8314 from Coahuila as *Ammoselinum giganteum*, but that collection, far-distant from the main range of that species, is identified here as typical *Ammoselinum popei* (see citation above).

Collections examined. **USA Arizona** Maricopa Co. 39 mi NW of Winterville, sandy flat among *Larrea*, 22 Mar 1936, *Wiggins* 8431 (UC). Pima Co. ca. 10 mi E of Tucson on Nogales Road, on open roadside, 2500 ft, 27 Apr 1945, *Gould* 3064 (ARIZ). Pinal Co. near Casa Grande, 3 Apr 1937, *Darrow* s.n. (ARIZ), Casa Grande, 1400 ft, fls faintly *Pastinaca*-scented, 2 May 1965, *McKay* 64 (ARIZ); Eloy, 25 Mar 1930, *Peebles, Harrison, & Kearney* 6496 (ARIZ-2 sheets).

*Spermolepis gigantea* is characterized by these features: umbels terminal and axillary, all pedunculate, involucre bractlets long, scarious-margined on the proximal 1/3–1/2, involucre bracts usually present, often ternate, peduncles, rays, and pedicels minutely hispidulous on the angles; and fruits relatively long, narrowly elliptic-ovate, hispid with non-pustulate-based hairs. The broad lateral ribs are perhaps the reason that it has been treated as a species of *Ammoselinum*.



Map 5. Distribution of *Spermolepis gigantea* and *S. infernensis*

Munz & Johnston (1925) included *Ammoselinum giganteum* and *A. occidentale* as the two members of *Ammoselinum* sect. *Hesperoselinum* Munz & Johnston, but Mathias and Constance (1944, p. 104), without comment, placed *A. occidentale* in the synonymy of *A. giganteum*, where it has since resided. Munz and Johnston observed that *Ammoselinum occidentale* differed from *A. giganteum* in its "lower more compact habit, unbranched stems, smaller more compact umbels, pubescent (rather than conspicuously callous-toothed) smaller carpels, and twice as many commissural oil tubes." In the observation here, however, the fruit vestiture is the same in both taxa, and Mathias and Constance (1944) treated *A. occidentale* as a synonym of *A. giganteum*. Mathias and Constance described the lateral fruit ribs of *A. giganteum* as having "corky appendages," but in the observation here, they are elaborated hardly more than the dorsal.

#### ACKNOWLEDGEMENTS

I am grateful for loans (to TEX) from ARIZ, FLAS, NMC, RSA, SJC, SRSC, and UC-JEPS and for hospitality at BAYLU, BRIT-SMU-VDB, NLU, and TEX-LL while studying there. Thanks to Mirta Arriaga at BA for providing close-up photos of the fruit of *Spermolepis castellanosi*, to Liora Spitz at CHRB for providing a digital image of the early collection of *Spermolepis divaricata* from New Jersey, to Sarah Taylor and Jochen Schenk at MACF for digital images of the McFadden collection of *Spermolepis lateriflora* from Los Angeles County, to John Pruski for a digital image and close examination of the fruits of *Pringle 8314* (MO), to Tim Flynn and David Lorence at NTBG for providing the image of *Spermolepis hawaiiensis*, to Jon Rebman and Mary Alice Kessler for observations on the fruit vestiture of SD collections (confirming their identity as *Spermolepis lateriflora*), to Carol Ann McCormick and Alan Weakley for information on NCU specimens, to Sam Kieschnick at BRIT for providing scanned images of several specimens, and to Stephen Downie for early comments on the taxonomy. This research has been supported in large part by the Flora of North America Association.

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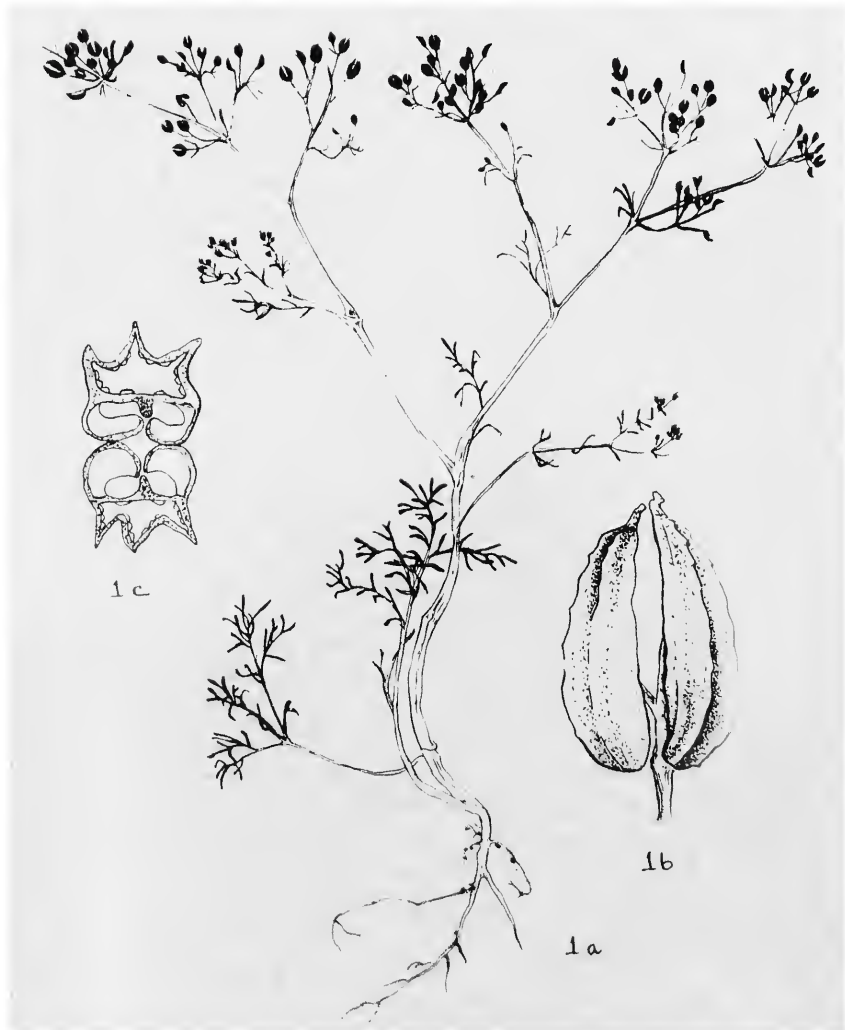


Figure 4. *Ammoselinum rosengurtii*, from original illustration (Mathias & Constance 1950). Used by permission of the Journal of the Torrey Botanical Society.





Figure 6. *Spermatolepis lateriflora*, representative collection (ARIZ).



Figure 7. *Spermolepis lateriflora*, representative plant, bottom left of Fig. 5 (ARIZ)





Figure 8. *Spermolepis echinata*, representative collection (FSU).



Figure 9. *Spermolepis hawaiiensis*, epitype (PTBG). Used by permission of the National Tropical Botanical Garden



Figure 10. *Spermelepis infernensis*, holotype (RSA).



Figure 11 *Spermolepis infernensis*, representative plant (from holotype, RSA)



Figure 12. *Spermolepis organensis*, holotype (NMC).



Figure 13 *Spermolepis inermis*, representative plant (SMU).





Figure 15. *Spermolepis divaricata*. representative plant (FSU).



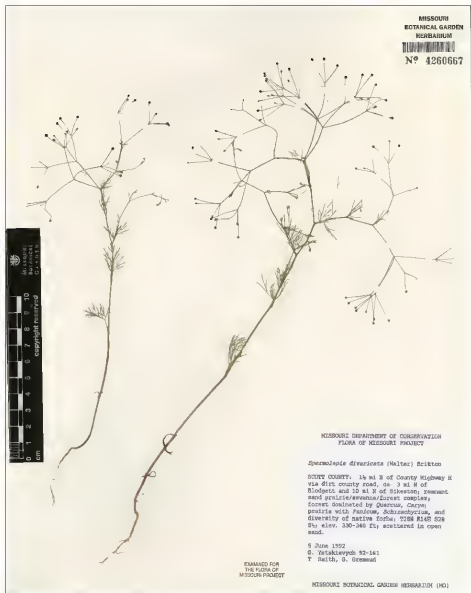


Figure 16 *Spermelepis diffusa* representative plant (MO).

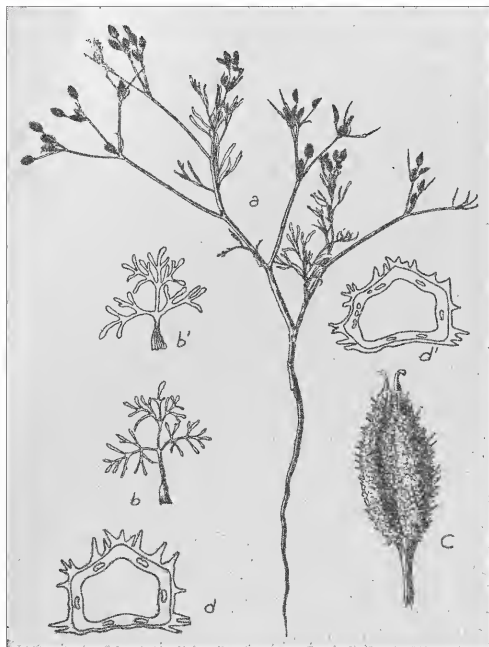


Figure 17. *Spermolepis castelknoosi*, from the original illustration (Pérez-Moreau 1940)



Figure 18. *Spermolepis gigantea*, representative plants (ARIZ).



Figure 19 *Ammoselinum giganteum* isotype (NY) = *Spermolepis gigantea*

Figure 20. *Ammoselinum occidentale* isotype (UC) = *Spermolepis gigantea*

## **BOERHAVIA COULTERI VAR. COULTERI (NYCTAGINACEAE), NEW TO CALIFORNIA**

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### **ABSTRACT**

*Boerhavia coulteri* var. *coulteri* is reported as new to California. The taxon was a major component among a dense population of two other boerhavia, *B. coulteri* var. *palmeri* and *B. triquetra* var. *intermedia*, that occurred for several kilometers along Interstate Highway 15 contiguous with the Nevada state line at Primm. The var. *coulteri* is rather weedy and seems to be spreading from its original range in the Sonoran Desert.

**KEY WORDS:** Nyctaginaceae, *Boerhavia*, San Bernardino Co., California, new record

While returning to New Mexico from a family visit to California I noted a dense stand of robust plants of *Boerhavia* at the edge of the pavement of Interstate Highway 15 on the filled roadbed of the highway that crosses the dry bed of Ivanpah Lake. The population extended for several kilometers west of the Nevada state line. The most westward plants noted were of *Boerhavia coulteri* var. *coulteri*, easily seen to be erect plants with bright green stems. Slightly eastward it was apparent at least one other *Boerhavia* with spreading, purplish stems occurred with the var. *coulteri*. My wife and I turned the car around in Primm and went back, quickly stopped on this very busy interstate, took location notes, hastily grabbed samples of each of the species, stuffed them in the back seat, and returned to a vacant parking lot in Primm to press them. Among the three taxa collected was the var. *coulteri*, a taxon not included in Murdock's excellent treatment of the Nyctaginaceae (Murdock 2012) in the recently revised Jepson Manual. Searches of relevant herbaria websites also reveal no specimens of the taxon collected in California. To my knowledge, this is the first report for California of *B. coulteri* var. *coulteri*, a Sonoran Desert taxon that seems to be spreading into surrounding areas as a weed in cities and along roadsides.

The record is as follows: *Boerhavia coulteri* var. *coulteri*. California. San Bernardino Co.: IH-15 on highway fill across Ivanpah Lake bed, 3 km SW of Nevada state line at Primm, 35°34.876', 115°24.130'; elev. 800 m, road shoulder on S side of interstate in area otherwise nearly barren of vegetation; plants part of a dense, robust, population of 3 taxa of boerhaviae intertangled among one another, the population ca. 4 km long, and 1–2 m wide; with *B. triquetra* var. *intermedia* (14458) and *B. coulteri* var. *palmeri* (14459), also with scattered *Kallstroemia grandiflora*, 12 Sept. 2012, R. Spellenberg and N. Zucker 14459 (RSA, to be deposited). Figure 1 shows all three taxa.

The three taxa are distinguished by the characters used in the Nyctaginaceae treatment for the Flora of North America (Spellenberg 2003). At this site they were also distinguished as follows:

*Boerhavia coulteri* (Hook. f.) S. Wats. var. *coulteri* – stems bright green, strongly ascending to erect; perianth pale pink; plants well into fruit maturation.

*Boerhavia coulteri* (Hook. f.) S. Wats. var. *palmeri* (S. Wats.) Spellenb. – stems purplish, widely spreading to ascending; perianth pink; plants just beginning fruit maturation.

*Boerhavia triquetra* S. Wats. var. *intermedia* (M.E. Jones) Spellenb. – stems green, stems spreading to erect; perianth pale pink; plants well into fruit maturation.



Figure 1. Photos of *Boerhavia* from the site at Ivanpah Lake, California, from specimens cited. A. *Boerhavia coulteri* var. *coulteri*; B. *B. coulteri* var. *palmeri*; C. *B. triquetra* var. *intermedia*. Fruits of A and B are 3.1 mm long; fruits of C are 2.5 mm long.

The short duration of the stop along this busy freeway did not allow a search for intergradation between the two varieties of *Boerhavia coulteri*. As noted in Spellenberg (2003), intergradient plants are occasionally encountered in Arizona. In this population the fruits on the specimen of var. *palmeri* that was collected are larger than indicated in Spellenberg (2003), about the same size as fruits of var. *coulteri* in this population. There was also little habitat separation noted between the taxa, with the exception that the var. *coulteri* was the first noted at the western end of the population, the other two species occurring eastward with *B. coulteri* var. *coulteri* in the mix. The phenological and morphological differences noted among these sympatric varieties suggest that species level classification may be preferable to varietal level classification within *B. coulteri*, but that decision should await careful studies among populations of both varieties.

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## THE AUTHOR AND TYPE OF *APIASTRUM ANGUSTIFOLIUM* (APIACEAE)

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### ABSTRACT

The correct author citation for the genus *Apiastrum* as well as two species and one variety, all published in 1840 by Torrey and Gray is "Nutt. in Torr. & Gray." Lectotypes for *Apiastrum angustifolium* and *Apiastrum latifolium* are at PH. The probable holotype of *Apiastrum angustifolium* var. *tenellum* is at PH.

**KEY WORDS:** *Apiastrum angustifolium*, author citation, type specimen

Within a day of posting of the study of *Spermolepis* and relatives (Nesom 2012), two scholars from the Harvard University Herbaria contacted me about misinterpretations regarding the authority and type of *Apiastrum angustifolium* as well as those of its synonyms. Corresponding corrections and other modifications are noted here.

### Authorities

Dr. Kanchi Gandhi observes that while the name of the genus is correct as *Apiastrum* Nutt. ex Torr. & Gray, as I had it, author citations for the three species of *Apiastrum* published in the same work (Flora of North America, Torrey & Gray 1840) should have been "Nutt. in Torr. & Gray," not "Nutt. ex Torr. & Gray, as I had those.

Torrey and Gray were working with a manuscript from Nuttall. For the names involved, they cited "Nutt. mss." for *Apiastrum* as the genus name (p. 643) and for *Apiastrum angustifolium* var. *tenellum* (p. 644). For *Apiastrum angustifolium* and *Apiastrum latifolium* (p. 644) they cited "Nutt. ! mss."

For each of the species and variety, a short description was given in quotes, evidently taken from Nuttall's manuscript. Additional descriptive notes, not in quotes, were provided for *A. latifolium* and the var. *tenellum*.

For the genus, nothing in the description is in quotes except for the concluding sentence, "Fruit with the taste of *Sison amomum*." At the very end of the description is "Nutt.," alluding either to the immediately preceding quote or to the whole genus description. Even if the "Nutt." were meant only in reference to the statement about fruit taste, the latter still would constitute part of the validating description and it appears that the authority for *Apiastrum* as a genus can be correctly cited as "Nutt. in Torr. & Gray," in the same way as for the species. The authority would be cited as "Nutt. ex Torr. & Gray" "when only the name but not the validating description or diagnosis was ascribed to a different author or to different authors" [vs. the publishing authors] (McNeill et al. 2006, ICBN 46.4).

In sum, it appears that authorities for all of these 1840 names in *Apiastrum* should be cited as "Nutt. in Torr. & Gray."



# Type specimen of *Apiastrum angustifolium*

I cited a Nuttall collection at GH as the "probable holotype" of *Apiastrum angustifolium*. Dr David Boufford, however, notes this: "Gray did not go to Harvard until 1842 and Nuttall's specimens at Harvard arrived even later, in 1864 from Elias Durand, so it seems the holotype may not be at Harvard. Most likely Torrey or Gray saw the specimen in Philadelphia, unless they saw specimens in Elias Durand's herbarium." And in any case, the authorship is attributed to Nuttall (in Torrey and Gray), thus recognition of original type material should reflect Nuttall's personal study.

My error in this went further, as the GH sheet that I cited (GH 00075076) was noted to have been collected in "north California" and possibly is not a duplicate of the explicitly labeled San Diego collections. The PH lectotype (Fig. 1) and the isolectotypes are clearly marked as to locality by Nuttall himself, matching the protologue.

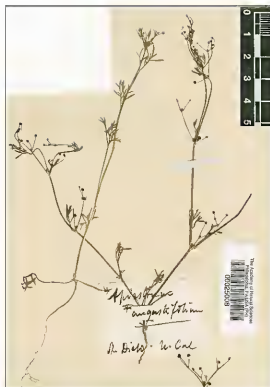


Figure 1. Lectotype of *Apiastrum angustifolium* (PH). These two plants are mounted at the upper right of the sheet. Three other collections are mounted on the same sheet.

The section on typification of the species is repeated here, incorporating the modifications suggested by Gandhi and Boufford, as well as other changes.

*Apiastrum angustifolium* Nutt. in Torr. & Gray, Fl. N. Amer. 1(4): 644. 1840. **LECTOTYPE** (designated here): USA. California. [San Diego Co.:] St. Diego, N Cal, [April, from protologue], *T. Nuttall s.n.* (PH barcode 00025008 digital image!, specimen at upper right of sheet; islectotypes: NY barcode 00405717 digital image!, PH barcode 00025009 digital image!, specimen on right half of sheet). The protologue specifies San Diego as the locality, and labels for all three collections have "*Apiastrum angustifolium*, St. Diego, n Cal." in Nuttall's hand. Citation of a duplicate of this at K was in error.

*Apiastrum angustifolium* var. *tenellum* Nutt. in Torr. & Gray, Fl. N. Amer. 1(4): 644. 1840. **TYPE**: USA. California. [Los Angeles Co.:] Catalina [Santa Catalina Island], no other collection data (probable holotype: PH bar code 00025006 digital image!, mounted in lower left of sheet with 3 other collections; see below).

Torrey and Gray did not indicate that they saw a collection; their concept of the taxon evidently was from Nuttall's manuscript. No specimen has been located that is marked as "var. *tenellum*" but a collection labeled in Nuttall's hand as "*Apiastrum angustifolium*, Catalina" is probably the specimen from which Nuttall's description was drawn. It is on the same sheet that has the lectotype of *Apiastrum angustifolium* and isotype of *Leptocaulis inermis* (each a Nuttall collection) and a J.M. Bigelow collection of *A. angustifolium* (identified as such in Nuttall's handwriting). The two very small "Catalina" plants, both less than 10 cm high and characteristic of the reduction that commonly occurs in annuals, match aspects of the brief description ("stem dichotomous from the base; leaves less divided; rays of the umbel very slender; umbellets 1–2-flowered; seed more rugulose"). This supercedes my earlier and illogical estimate that an 1899 collection by E. Palmer was the probable type.

*Apiastrum latifolium* Nutt. in Torr. & Gray, Fl. N. Amer. 1(4): 644. 1840. **LECTOTYPE** (designated here, superceding the earlier choice of GH 00075075): USA. California. [Santa Barbara Co.:] "St. Barbara, n Cal." [on PH sheet], no other collection data, *T. Nuttall s.n.* (PH 01044838 digital image!, islectotypes: BM digital image!, NY barcode 00405718 digital image!, specimen on right half of sheet; possible islectotypes: GH 00075075, GH 00075076). Torrey and Gray cited "Nuttall! Douglas!" The two sheets at GH were collected by Nuttall in "north California," with no other indication of locality. The PH, NY, and BM labels give Santa Barbara as the locality, although the protologue does not specify a locality, and all three give Nuttall's own identification (in his hand) as *Apiastrum latifolium*.

The earlier attempt to designate a lectotype (Nesom 2012, 19 September) was incorrect from several perspectives. As pointed out by Dr. Boufford, the GH sheet was unlikely to have been part of the original material studied by Torrey and Gray, nor is it clear that it was part of the material upon which Nuttall based his concept. Only the labels at PH, NY, and BM have the identification of *Apiastrum latifolium*; those at GH are not identified with any name thus are perhaps or probably not duplicates of the explicitly identified specimens.

*Helosciadium leptophyllum* var. ? *latifolium* Hook. & Arn., Bot. Beechey Voy., 347. 1838. No collection was cited (pp. 347–348). The protologue gave only this: "The specimens are only in young fruit, and the segments of the upper leaves are considerably broader than in any form we have yet seen, while even the lower ones are broader than in *H. laciniatum*, DC., which we consider a mere variety of this species." As synonym of *Apiastrum* fide Mathias and Constance (1945).

#### ACKNOWLEDGEMENTS

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## *VERNONIA FASCICULATA* (ASTERACEAE): NEW TO THE FLORA OF TEXAS

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### ABSTRACT

*Vernonia fasciculata* is reported new to the flora of Texas. It was collected on 9 Sep 2012 on a narrow remnant strip of low-lying “pocket prairie” along Hwy 37 in Red River County, Texas. These “pocket prairie” remnants are in dire need of study and conservation.

**KEY WORDS:** Asteraceae, *Vernonia*, *Vernonia fasciculata*, Red River County, Texas, “pocket prairie”

*Vernonia fasciculata* Michaux, prairie ironweed, is a native species that occurs most abundantly on the northern Great Plains and in the upper Midwest, though it occurs from the Prairie Provinces of Canada east to Ohio south to Colorado, Oklahoma, Arkansas, Mississippi, and Alabama (BONAP 2012). It was not listed for Texas by Correll and Johnson (1970), Jones et al. (1997), Turner et al. (2003), or BONAP (2012).

*Vernonia fasciculata* is a species of “the cool temperate zone” (Jones 1972), where it grows in a variety of mesic habitats including “bottomlands, ditches, and low prairies” (Strother 2006). It is closely related to *V. marginata* of west Texas and Oklahoma and Correll and Johnson (1970) suggested they might be treated as conspecific, a notion dispelled by Jones (1972) who treated the duo as the Fasciculatae Group.

On September 9, 2012, a small population of *Vernonia fasciculata* was found on an unmowed roadside near Negley in Red River County, Texas, five miles south of the Red River on a terrace along Pecan Bayou. Nearly two dozen plants were growing on a narrow remnant strip of high-quality “pocket prairie.” This species was confined to a strip no more than 10 yards wide and 30 yards in width. Apparently this small remnant was protected from destruction by the right-of-way of Texas Hwy 37. Associated species included *Andropogon gerardii*, *Verbesina alterniflora*, *Solidago odora*, *Symphytotrichum pratense*, *Helianthus mollis*, and *Pteridium aquilinum*. A stand of *Vernonia baldwinii* was growing 50 yards away, but plants of that species were not found in the *V. fasciculata* colony.

Plants of *Vernonia fasciculata* (Figs. 1–4) were easily distinguished in the field by the corymbose inflorescence and toothed leaves with scabrous adaxial surface and glabrous abaxial leaf surfaces, as well as the fasciculate flowering heads (which were still in bud) in the axils of the upper cauline leaves. The leaf of a freshly collected specimen scanned at 3600 dpi resolution revealed that the abaxial leaf surface contained numerous pits, each containing a tiny awl-shaped hair (Fig. 2). Four North America species of *Vernonia* have awl-shaped hairs in the pits on the abaxial leaf surface, including *V. fasciculata*, *V. marginata*, *V. lettermannii*, and *V. texana* (Strother, 2006). Only *V. fasciculata*, though, has a corymbiform inflorescence and leaves with toothed margins.

Voucher specimen: Texas. Red River Co.: Texas Hwy 37, N of Negley, E side of hwy, 4.9 miles S of Red River bridge, 33° 47' 32.93 N, 95° 03' 12.16" W, 9 Sep 2012, *M. White s.n.* (BAYLU).

The soils at the site are mapped as the Whakana-Elysian complex with 0-1% slopes. This complex, which formed in alluvial sediment, is a mixture of soil types and contains numerous “pimple” mounds. In Red River County these soils occur on nearly level terraces ranging from 5 to 150 acres in size, with an average of 45 acres. The Whakana is a gray loam about 14 inches thick and makes up the largest surface area of the complex. The circular protruding “pimple” mounds consist of Elysian loam, a fine brown sandy loam about 6 inches thick. The moist depressions in this complex are mapped as Wrightsville soils and range from 5 to 8 acres in size (Thomas 1977).

This site, like the recently discovered Godley and Little Prairies in nearby Bowie County to the east, was originally a “pocket prairie” surrounded by mixed hardwood and shortleaf-pine savannah (Singhurst et al., 2011). However, unlike those two high-quality hay meadows, apparently only a narrow sliver of this “pocket prairie” remains along the narrow right-of-way of Texas Hwy 37. Images in the Soil Survey of Red River County, Texas (Thomas 1977) as well as recent Google Earth reveal the original shape of the part of this “pocket prairie” on private property west of the highway though unfortunately, east of the highway the site has been converted to extensive pine plantations.

Seven species of *Vernonia* and one putative hybrid are mapped for Texas by Turner et al. (2003). Although *Vernonia fasciculata* was earlier reported for Texas by Heller (1894), the specimen in question was later determined to be the hybrid *Vernonia* X *guadalupeensis*—a cross between *V. baldwinii* and *V. lindheimeri*. The discovery of *V. fasciculata* makes the eighth species in the genus known from Texas. The closest populations to the Red River County plants apparently are in McCurtain County, Oklahoma, immediately north of Red River County.

This discovery underscores the need both to protect and to study the few remaining “pocket prairie” remnants in the Texas, especially those in the northeastern corner of the state, where little botanical field work has been conducted. As recent discoveries in this area have made clear, the prairie flora in this region is influenced by the upper Midwest and the northern Great Plains.

#### ACKNOWLEDGEMENTS

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Figure 1: *Vernonia fasciculata*. Flowering head at 3600dpi. Note the lance-ovate outer phyllaries and oblong to linear-oblong inner phyllaries with arachno-crenulate margins. Note also the phyllaries in four series. Flatbed scan by Matt White



Figure 2. *Vernonia fasciculata* abaxial and adaxial leaf surfaces at 3600 dpi. On the abaxial leaf surface, note the numerous pits, each containing a small awl-shaped hair. On the adaxial leaf surface note the scabrellous resin dotted glands and the occasional pits. The distinctive toothed margins are clearly visible. Flatbed scan by Matt White.



Figure 3. *Vernonia fasciculata* in a remnant “pocket” prairie five miles south the Red River in Red River County, Texas, 9 September 2012. Note the corymboid inflorescence as well as the fasciculate flowering heads in the axils of the upper leaves, for which the species is named. Photo by Matt White.





Figure 4. *Vernonia fasciculata*. Inflorescence. 15 September 2012.

A NEW SPECIES OF *AGERATINA* (ASTERACEAE: EUPATORIEAE)  
FROM SINALOA, MEXICO

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ABSTRACT

A new taxon, *Ageratina concordiana* B.L. Turner, sp. nov., belonging to the *A. capillipes* complex, is described from southern Sinaloa. A photograph of the type is provided, along with a map showing the distribution of the new species and other members of the complex.

**KEY WORDS:** Asteraceae, Eupatorieae, *Ageratina*, *A. capillipes*, Mexico, Sinaloa

Ongoing identification of the Asteraceae from Mexico has occasioned the present paper.

**AGERATINA CONCORDIANA** B.L. Turner, sp. nov. Figure 1. **TYPE:** MEXICO, Sinaloa. Mpio. de Concordia: Transecto de Rancho Coyotes a El Pirame, Comunidad La Guásima, herbácea común localmente en la zona de trompetas-roblar, 23° 23.289' N, 105° 58.7' W — 23° 24.911' N, 105° 59.387' W, 411–728 m, 3 Mar 2010, *Marcela Ruiz Guerrero 2010-105* [with Albert van der Heiden] (holotype: TEX).

Resembling *Ageratina reserva* B.L. Turner, differing in having larger, sub-cordate blades, ultimate peduncles minutely glandular pubescent, and smaller heads (ca 4 mm high vs. 5 mm).

Perennial herbs, 50 cm high or more. Midstems sparsely pubescent with minute hairs or glabrate. Leaves (upper), 11–14 cm long, 6–7 cm wide; petioles 4–6 cm long, pubescent like the stems, grading into the blades; blades subcordate, glabrous above and below, or nearly so, 3-nervate from the very base, margins irregularly serrate. Heads ca 4 mm high, 3 mm wide, numerous and arranged in both lateral and terminal congested cymose panicles, ultimate peduncles 2–5 mm long, minutely glandular pubescent. Involucral bracts 16–18, 2–3 mm long, glabrous or nearly so, arranged in 2 series. Florets 12–20 per head; corollas white, ca 2.5 mm long, lobes sparingly pubescent. Achenes (immature) ca 1 mm long, sparsely pubescent; pappus of ca 10 fragile, pinkish, bristles ca 1.5 mm long. Noted by collectors to have "olor dulce a miel."

The epithet is derived from the Mpio. de Concordia, whence the type.

In my treatment of *Ageratina* for Mexico (Turner 1997), the novelty will key directly to *A. helenae* King & Rob., a mostly Central American species treated as a synonym of *A. capillipes* by Williams (1976). I now believe that *A. helenae* is confined to Central America.

*Ageratina concordia* clearly belongs to the *A. capillipes* King & Rob. complex of Mexico (sensu Turner 2012), where it will key to the Chiapasan *A. reserva* B.L. Turner, differing from the latter in having larger, subcordate blades, ultimate peduncles minutely glandular pubescent and smaller heads (ca 4 mm high vs 5 mm). With description of the present novelty, the complex in Mexico now includes 5 species (Fig. 2). The following key, modified from that presented by Turner (2012), should help identify the taxa concerned.



Figure 1. *Ageratina concordiana* (holotype TEX).



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**TWO RECENT PLANT DISCOVERIES IN MISSOURI:  
*CLADIUM MARISCUS* SUBSP. *JAMAICENSE* (CYPERACEAE)  
AND *UTRICULARIA MINOR* (LENTIBULARIACEAE)**

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**ABSTRACT**

Here we report the first Missouri records for *Cladium mariscus* (L.) Pohl subsp. *jamaicense* (Crantz) Kük. (Cyperaceae) and *Utricularia minor* L. (Lentibulariaceae). Both taxa are documented from The Nature Conservancy's Shut-in Mountain Fens Preserve in Shannon County, within the Ozark Highlands ecoregion of southeastern Missouri.

**KEY WORDS:** Cyperaceae, Lentibulariaceae, *Cladium*, *Utricularia*, Missouri, Shannon County

Shut-in Mountain Fens Preserve is a 520-acre (210 ha) Nature Conservancy preserve characterized by rugged igneous knobs of Precambrian rhyolitic ash flows overlain by deep beds of dissected Ordovician dolomite. Below the small exposed igneous glade at the summit of Shut-in Mountain, the site is primarily oak-hickory woodland, with a minor component of shortleaf pine (*Pinus echinata*). Total relief within the preserve is 100 meters. The geology and topography create several areas of permanent minerotrophic groundwater discharge along Wildcat Hollow, the small, northeast-trending, intermittently flowing drainage that passes through the site. These phreatic discharges range from numerous small seepage areas of a few square meters to three fens ranging up to 1.0 ac (0.4 ha). The vegetation of these fen areas is briefly described below; data on dominant vascular plants are from Ladd (2010).

The central fen in this complex is categorized as Ozark Fen by Nelson (2010), and supports a rich assemblage of plants whose Ozark distribution is restricted to fen systems. Dominant plant species in this fen are *Rudbeckia fulgida* var. *umbrosa*, *Parnassia grandiflora*, *Scleria verticillata*, *Vernonia missurica*, and *Oxypolis rigidior*.

A few hundred meters upstream (west) from this fen is an unusual fen area characterized by an expanse of seeping marly gravel over dolomite bedrock. While this site likely supported Ozark fen historically, past land use history of this area has resulted in the loss of virtually all organic substrate, creating an unusual minerotrophic wetland dominated by a sparse cohort of *Rhynchospora capillacea*, *Physostegia virginiana*, *Silphium terebinthinaceum*, *Panicum virgatum*, and *Fuirena simplex*.

The easternmost fen has strong biological affinities to dolomite glade, and consists of a ca. 0.5 ac (0.2 ha) gently sloping open seepage over surfacing flats of dolomite bedrock. Dominant plant species here are *Scleria verticillata*, *Schizachyrium scoparium*, *Rudbeckia missouriensis*, *Rhynchospora capillacea*, *Limn. floridanum*, and *Panicum virgatum*.

Shortly after The Nature Conservancy acquired the site in 1988, a regime of frequent dormant season fires was implemented in much of the preserve. The drainage containing the three fens has been burned 17 times since its acquisition by the Conservancy. This fire management has increased botanical diversity within the fen. Of particular note, the second-known and largest population of *Pogonia ophioglossoides* in Missouri emerged following application of prescribed fire. Several plant taxa of conservation concern or taxa previously unknown in the state have been documented at the site including *Equisetum* × *nelsonii*, *Ludwigia microcarpa*, *Scleria verticillata*, and *Utricularia subulata*.

### *Cladium mariscus* subsp. *jamaicense*

Since 2007, representatives from The Nature Conservancy have observed a slowly increasing vegetative population of a large sedge along the upper margin of the easternmost fen; this was subsequently identified as *Cladium mariscus* (L.) Pohl subsp. *jamaicense* (Crantz) Kük. by the authors. As of 2011, this population had grown to a dense stand of several thousand stems dominating an area measuring approximately 18 × 7 meters. In 2010, only two fertile culms from the previous growing season were located; a few fertile stems were also documented in 2011. Associated plant species include: *Andropogon gerardii*, *Aptis americana*, *Eupatorium perfoliatum*, *Fuirena simplex*, *Helianthus autumnale*, *Liatris pycnostachya*, *Lysimachia quadriflora*, *Oxyopsis rigidior*, *Panicum virgatum*, *Pycnanthemum virginianum*, *Rhynchospora capillacea*, *Rudbeckia fulgida* var. *umbrosa*, *Salix caroliniana*, *Sorghastrum nutans*, *Symphotrichum lateriflorum*, and *Vernonia missurica*.

Voucher specimens: MISSOURI. Shannon Co.: The Nature Conservancy's Shut-in Mountain Fens Preserve, along the south side of Shannon County H-522, ca. 1.4 mi NE of the jct of hwy H and NN, ca. 7.5 mi E of Eminence; large, mostly vegetative colony in partial shade along upper side of easternmost fen, in gently sloping gravelly/marly seepage with exposed dolomite bedrock; 37° 06' 35.82"N, 91° 13' 39.35"W, 21 Apr 2010, Thomas 2349 (MO); 24 August 2011. Ladd 32234 (KANU, MO).

This is the northwesternmost, though not westernmost, record of *Cladium mariscus* subsp. *jamaicense*, and represents a significant range extension as well as the first record for Missouri. This species is dominant in marshes of the Florida Everglades (Tucker 2002), and it occurs primarily in coastal marshes from Virginia to Texas and also in Hawaii (Tucker 2002; BONAP 2012). Additional inland populations in the United States have been reported from Georgia, Arkansas, Texas, and New Mexico (NatureServe 2010; USDA, NRCS 2010; T. Witsell, personal communication, 15 November 2010; BONAP 2012). *Cladium mariscus* subsp. *jamaicense* is also known from Mexico, the West Indies, Central America, and northern South America (Tucker 2002). The Missouri population of *C. mariscus* subsp. *jamaicense* is more than 400 km north of the closest documented sites in southern Arkansas (Tucker 2002; T. Witsell personal communication, 15 November 2010; NatureServe 2010; USDA, NRCS 2010; BONAP 2012).



Figure 1. *Cladium mariscus* ssp. *jamaicense* at Shut-in Mountain Fens Preserve. Photograph by Justin Thomas.

In North America, *Cladium mariscus* subsp. *jamaicense* typically occurs in brackish and freshwater marshes (Tucker 2002). However, the Missouri population occurs on the margin of a marly fen. The precedent to occur in minerotrophic fen wetlands is not unexpected; the Old World counterpart to our taxon, the questionably distinct var. *mariscus*, is a dominant species in calcareous fens in Europe (EUNIS Biodiversity Database 2012), where the common name for the plant is “Great Fen Sedge.”

Only three species of *Cladium* occur in North America — *C. californicum*, *C. mariscoides*, and *C. mariscus* subsp. *jamaicense*. *Cladium mariscus* subsp. *jamaicense* and *C. californicum* differ from *C. mariscoides* in having taller and broader culms, broader leaves with serrate margins, and taller inflorescences with a greater degree of branching (Tucker 2002). *Cladium mariscus* subsp. *jamaicense* is questionably distinct from *C. californicum*, and reportedly differs in having spikelets in smaller groups, inflorescences with third and fourth order branches, and taller culms (Tucker 2002). For a key and a full description of these taxa, see Tucker (2002).

The nativity and ecological status of the Missouri population of *Cladium mariscus* ssp. *jamaicense* is uncertain. There is strong reason to suspect that this population is a recent introduction, as evidenced by its occurrence well outside the previously documented range, its recent discovery in a well-investigated site visited annually by botanists, its proximity to a road, and its steadily increasing population at a single locus in the area. On the other hand, the species is not cultivated, and it is not considered to be ecologically opportunistic or weedy. The continued discovery of conservative native vascular plant taxa at Shut-in Mountain Fens Preserve also raises the slight possibility that habitat management at this site has resulted in the resurgence of a relict population of *C. mariscus* ssp. *jamaicense*.

### *Utricularia minor*

In April 2010 the authors also documented extensive populations of *Utricularia minor* L. from shallowly inundated marly substrate in all three fen communities within Shut-in Mountain Fens Preserve. A subsequent survey of the three fen openings revealed 385 flowering stems in both marl-dominated openings and in the pools of deep muck zones. Plants were common in areas of permanent inundation that lacked visible flow. Though no other species of vascular plants were detected in the immediate microhabitat of the *U. minor* plants, the tussocks and higher (saturated but



not inundated) ground contained such species as: *Rhynchospora capillacea*, *Carex leptalea*, *Panicum virgatum*, *Carex sterilis*, and *Silphium terebinthinaceum*.

Voucher specimen: MISSOURI. Shannon Co.: The Nature Conservancy's Shut-in Mountain Fens Preserve, along the S side of Shannon County H-522, ca. 1.4 mi NE of the jct of hwy's H and NN, ca. 7.5 mi E of Eminence; from marly openings in westernmost fen, 37° 06' 24.33" N, 91° 14' 05.47" W, 30 Apr 2010, Thomas 2343 (MO).



Figure 2. *Utricularia minor* at Shut-in Mountain Fens Preserve. Photograph by Justin Thomas

*Utricularia minor* is a circumboreal species, concentrated in the conterminous United States in New England and the northern Great Lakes states, and occurring at scattered localities from the Dakotas and central Nebraska west to Washington, Oregon, and California (Neid 2006; BONAP 2012). This collection represents a significant range extension for this species. The nearest known locations for *U. minor* are two ponds in Saline and Clay counties, Illinois, where the species was collected in 1964 and 1965, respectively (Dolbeare and Ebinger 1974; Harkert and Ebinger, eds., 2002). These southern Illinois collections represent possible introductions or waifs (Harkert and Ebinger, eds., 2002); the species is otherwise concentrated in far northeastern Illinois and, to the west, occurs no closer to Missouri than north-central Iowa (BONAP 2012). The species is also disjunct in the southeastern United States in high-elevation fens and bogs in the Southern Blue Ridge Mountains in western North Carolina (Weakley 2011).

Throughout its range, *Utricularia minor* typically inhabits low-nutrient, anaerobic wetland habitats. In New England and the Great Lakes states, *U. minor* inhabits a variety of wetlands, including shallow ponds, peaty lake margins, fens, sedge meadows, and marshes, often in shallow water or disturbed areas such as tire ruts and animal trails (Voss 1996; Chadde 2002; Magee and Ahles 2007). The species generally shows a preference for calcareous soils (Voss 1996; Chadde 2002). In the western United States, the species is scattered and local, and typically occurs in seeps, floating mats, shallow water, and saturated peat in calcareous fens and associated habitats at elevations typically greater than 2,100 m (7,000 ft) (Neid 2006). In Alaska, *U. minor* is known from quiet water and mud habitats (Hultén 1968). Although *U. minor* is considered to be globally secure, the species is rare across much of its North American range, and it is considered critically imperiled in Illinois, Indiana, Iowa, New Jersey, Utah, and Prince Edward Island; imperiled in Colorado, Nebraska, New York, North Dakota, Oregon, Washington, Wyoming, New Brunswick, and Saskatchewan; and vulnerable in California, Ohio, and Manitoba. In addition, *U. minor* is considered extirpated from Delaware and is known only from historical collections from North Carolina and Rhode Island (Neid 2006).

The genus *Utricularia* L. is diverse worldwide, but only 20 species are documented from the United States and Canada, and only three species were previously documented from Missouri: *U. gibba* L.; *U. macrorhiza* J. Le Conte; and *U. subulata* L. (Steyermarck 1963; Neid 2006; BONAP 2012). *Utricularia minor* can be differentiated from *U. subulata*, which also occurs at the site, by its numerous, dichotomous or irregularly divided leaves (vs. leaves absent or linear for *U. subulata*) and by its small, cream-colored flowers with the spur approximately half the length of the lower lip (vs. flowers yellow with the spur about equaling the lip in *U. subulata*) (Gleason and Cronquist 1991). *Utricularia minor* can be differentiated from *U. gibba* and *U. macrorhiza* by its lower corolla lip, which is approximately twice as long as the upper lip (vs. lower corolla lip equaling or slightly longer than the upper lip in *U. gibba* and *U. macrorhiza*) and its flat ultimate leaf segments (vs. ultimate leaf segments filiform in *U. gibba* and *U. macrorhiza*) (Gleason and Cronquist 1991).

Based on its occurrence in a typical habitat (calcareous fen), the rarity and local distribution of calcareous fens in southern Missouri (Nelson 2010), and the documentation of numerous scattered populations in similar wetlands in several western states over the past half-century (Neid 2006), the population of *Utricularia minor* at Shut-in Mountain Fens Preserve is likely a native occurrence. In addition, *U. minor* is a very small, inconspicuous, easily overlooked plant, and flowers early in spring when its calcareous fen habitat appears barren of vegetation without close inspection. Systematic inventories of calcareous fens, seeps, and pond shores in the surrounding region in April or early May may reveal additional populations of this locally rare bladderwort species in southern Missouri.

#### ACKNOWLEDGEMENTS

Our thanks to George Yatskievych and Garrett Crow for verification of identification of *Utricularia minor*, to Doug Ladd for providing background information about Shut-in Mountain Fens Preserve and the *Cladium mariscus* subsp. *jamaicense* population, and to Susan Farrington for her assistance with stem counts and collection of additional specimens.

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## SANGUISORBA MINOR (ROSACEAE) ADVENTIVE IN TEXAS

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### ABSTRACT

*Sanguisorba minor* is reported as occurring in Texas. A key to the two species of the genus now known in the state and comments on the distribution of each species in the USA are included. The invasive potential of the species is briefly mentioned.

**KEY WORDS:** Rosaceae, *Sanguisorba*, United States, Texas, adventive species.

The following specimen documents the occurrence of *Sanguisorba minor* as adventive and naturalized in the state of Texas.

TEXAS. Fannin Co.: From Honey Grove, 1.9 mi W of jct of Texas Hwy 34 and Texas Hwy 56 on Hwy 56, then 1.1 mi N of jct of FM 1396 and Hwy 56 on FM 1396, 19 Jun 2012, Singhurst, Womack, Clark, & Warriner 19309 (BAYLU). Figure 1.

*Sanguisorba minor* was located in a seepage transition between an upland prairie and the edge of a small reservoir (tank). Associated flora at the edge of the reservoir included *Juncus texanus*, *Eleocharis montevidensis*, *Lycopus americanus*, *Lythrum alatum*, *Eupatorium* sp., *Samolus parviflorus*, and *Pluchea odorata*. This aquatic system was located within an upland tallgrass prairie on clay soil over the Gober Chalk Geological Formation. The upland prairie was dominated by *Schizachyrium scoparium*, *Bouteloua curtipendula*, *Sporobolus compositis*, *Silphium laciniata*, *Baptisia australis*, *Dalea purpurea*, *D. compacta*, *Liatris squarrosa* var. *glabrata*, and *L. aestivalis*.

The species is a native or Eurasia (Fernald 1950), with the present Old World distribution being Europe, westward through central Asia to the Himalayas, northwest Africa and Libya (Hortipedia 2012). The species has been introduced to western USA (New Mexico to Montana and westward) and the northeast USA (Tennessee-North Carolina northward) (USDA, NRCS 2012). The origin of the species in Texas is apparently related to the use of the species as forage for livestock and wildlife (Carr & Smith 2010). In that work, *Sanguisorba minor* is specifically discussed as an agricultural crop but the article does not provide the standard botanical protocols for reporting additions to the flora of a state.

*Sanguisorba minor* is an early introduction to the United States, being mentioned as such by Torrey and Gray (1840) under the synonym *Poternum sanguisorba* L. Bailey (1949) described the status of the species as "somewhat nat[uralized] in N. Amer." Gleason and Cronquist (1963) remarked that the species is "established as a weed along roadsides and in fields and in waste places here and there in our range" (northeast United States and adjacent Canada). Voss (1985), in the



Michigan Flora, mentioned “Despite the common names [Garden or Salad Burnet], this Old World species is apparently not cultivated to any extent in this country, but is a very local weed.” As evaluated from the above comments, it does not appear that the species will present ecological problems in the state, other than not being a native part of the flora of Texas.

Several subspecific names are recognized in *Sanguisorba minor*. The Texas plants are nearest to *S. minor* subsp. *balearica* (Bourgeau ex Nyman) Muñoz, Garmendia, & C. Navarro.



Figure 1. *Sanguisorba minor* in Fannin County, Texas. Photo by Jason Singhurst, 19 June 2012.

This is the second species of *Sanguisorba* reported to occur in Texas, the other being *S. annua* (Nutt.) Nutt. The two species may be distinguished by use of the following key, which is modified from Radford et al. (1968).

- 1. Leaflets pectinately dissected nearly to midrib, segments about 1 mm wide, plants annual ..... ***Sanguisorba annua***
- 1. Leaflets merely coarsely toothed, to ca. 7 mm wide; plants perennial ..... ***Sanguisorba minor***

*Sanguisorba annua* is widely distributed in the western USA but sparingly so in the East, where USDA, NRCS (2012) cites its presence in South Carolina, Maryland, New York, and Massachusetts. In Texas the species exhibits an approximately triangular shaped distribution in the north central portion of the state, basically from Travis County northward to Fannin County, west to Wichita County and also Maverick County of the South Texas Plains (distribution determined from specimens cited in the Flora of Texas Database (2012) and specimens in the Baylor University Herbarium [BAYLU]).



There is no uniformity in the author citation of *Sanguisorba annua*. Diggs et al (1999) have used (Nutt. ex Hook.) Torr. & A.Gray, USDA,NRCS (2012) uses (Nutt. ex Hook) Nutt. ex Torr. & A.Gray, and the International Plant Names Index (2012) uses (Nutt.) Nutt., which we followed.

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## TAXONOMY OF THE GENUS *VESPER* (APIACEAE)

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### ABSTRACT

A species group often broadly treated within *Cymopterus* but historically segregated as the genus *Phellopterus* Coulter & Rose 1900 is restored here to generic rank. A new name for the genus, *Vesper* Hartman & Nesom, is provided because of the earlier *Phellopterus* Benth. 1867. Six species are included: *Vesper bulbosus* (A. Nels.) Hartman & Nesom, comb. nov., *Vesper constancei* (Hartman) Hartman & Nesom, comb. nov., *Vesper macrorrhizus* (Buckley) Hartman & Nesom, comb. nov., *Vesper montanus* (Nutt. in Torr. & Gray) Hartman & Nesom, comb. nov., *Vesper multinervatus* (Coulter & Rose) Hartman & Nesom, comb. nov., and *Vesper purpurascens* (A. Gray) Hartman & Nesom, comb. nov. The genus is distinct in its combination of thick taproots, acaulescent habit but consistent production of pseudoscapae, compact inflorescences, white to cream, pink, or purple petals, dorsally compressed mericarps with 4–5, thin, broad dorsal and lateral wings and with 3–9 oil tubes per interval, and particularly by its involucre bracts basally connate, prominently nerved, and totally white to purplish-scarious or with broad white-scarious margins.

**KEY WORDS:** Apiaceae subfamily Apoideae, *Cymopterus*, *Vesper*, Sun and Downie

Many generic segregates have been proposed among species of the "perennial, endemic western North American Apiaceae subfamily Apoideae" (sensu Downie et al. 2010) toward describing patterns of diversity within this group. Most of the wing-fruited species and their generic-level segregates, however, have recently been treated within a relatively inclusive *Cymopterus* Raf. (e.g., Mathias & Constance 1944-45; Cronquist 1997; Turner 2003; Welsh et al. 2008), currently including about 40 species. Limits of the genus *Aletes* were expanded (e.g., Weber 1984) to encompass some of the species.

The present study confirms the morphological and phyletic integrity of one strongly differentiated species group (the *Phellopterus* group) — it is treated here as a distinct genus, though requiring a new name. Six species are included: *Cymopterus bulbosus*, *C. constancei*, *C. macrorrhizus*, *C. montanus*, *C. multinervatus*, and *C. purpurascens*.

This species group is monophyletic in recent molecular analyses based on sequence variation in nrDNA ITS and cpDNA *rps16* intron and *trnF-L-T* (e.g., Sun & Downie 2010). In a strict consensus tree of 240 minimal length trees derived from MP analysis of combined molecular and morphological characters for 129 accessions of North American Apoideae, the *Phellopterus* group has values of 100% for bootstrap estimates and Bayesian posterior probability. The group also is consistently and strongly coherent in morphology, as indicated by the characters in the diagnosis below.

Except for the recent addition of *Cymopterus constancei* by Hartman (2000), this same species group was first segregated by Coulter and Rose (1900) as the genus *Phellopterus* and later also recognized by Mathias (1930) at generic rank. Although most recent treatments have placed the *Phellopterus* group within *Cymopterus*, species keys consistently separate the species as a group by the same set of earlier-recognized characteristic features.

**VESPER** R.L. Hartman & G.L. Nesom, **nom. nov.** *Phellopterus* (Nutt. ex Torr. & A. Gray) Coulter & Rose, Contr. U.S. Natl. Herb. 7: 166. 1900 (nom. illeg., not *Phellopterus* Benth. 1867 = *Glehnia* F. Schmidt ex Miq.). *Cymopterus* sect. *Phellopterus* Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1: 623. 1840. **TYPE:** *Cymopterus montanus* Nutt. in Torr. & A. Gray

Bentham's *Phellopterus* comprised the single entity *Phellopterus littoralis* (A. Gray) Benth. now treated as *Glehnia leiocarpa* Mathias or *Glehnia littoralis* var. *leiocarpa* (Mathias) Boivin.

*Cymopterus* sect. *Leptocnemia* Nutt. ex Torr. & Gray, Fl. N. Amer. 1: 624. 1840. **TYPE:** *Cymopterus campestris* Nutt. in Torr. & Gray

Distinct in its combination of thick taproots, acaulescent habit but consistent production of pseudostapes, compact inflorescences, white to cream, pink, or purple petals, dorsally compressed mericarps with 4–5, thin, broad dorsal wings (3) and lateral wings (2) and with 3–9 oil tubes per interval, and particularly by its involucre bracts basally connate, prominently nerved, and totally white to purplish-scarious or with broad white-scarious margins. Outer umbellets of staminate flowers, inner ones of pistillate or staminate flowers in part; carpophore bifid to base or absent.



Figure 1. *Vesper bulbosus* from Montezuma Co., Colorado, 27 March 2005. Photo ©Al Schneider, [www.swcoloradowildflowers.com](http://www.swcoloradowildflowers.com).





Figure 2. *Vesper bulbosus*. Same plant as Fig. 1.

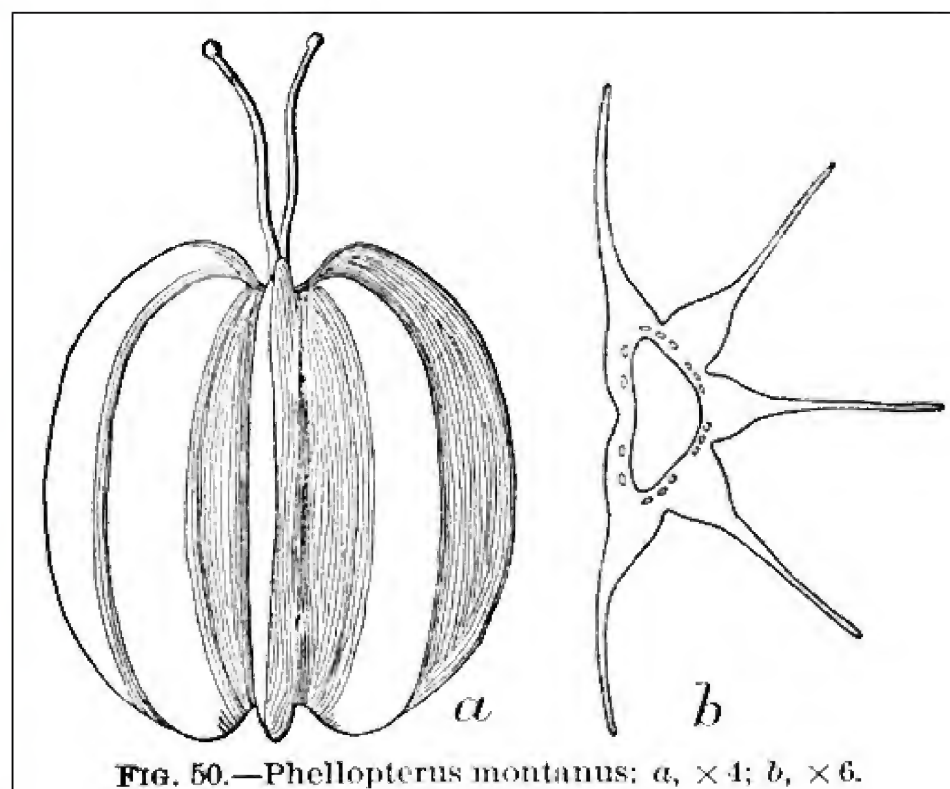


FIG. 50.—*Phellopterus montanus*: a,  $\times 4$ ; b,  $\times 6$ .

Figure 3. Representative mericarps of *Vesper*. a. Dorsal view. b. Cross-section showing dorsal compression, wings, and oil tube. From Coulter and Rose (1900).



Figure 4. *Vesper constancei* from Dolores Co., Colorado, May 2010. Photo ©Al Schneider, [www.swcoloradowildflowers.com](http://www.swcoloradowildflowers.com).

The new name of the genus is from Latin, *vesper*, evening or west, sometimes referring to the "evening star" (usually Venus) seen at sunset in the western sky. The name alludes to the team of Sun and Downie, who have provided molecular analyses (Feng-Jie Sun and Stephen R. Downie 2004, 2010; and including Downie et al. 2002) indicating that evolutionary relationships among many of the currently and historically recognized genera of western North American Apioideae are complex, apparently reticulate.



## KEY TO THE SPECIES

1. Fruiting peduncles shorter than or equalling the leaves; mericarp wings conspicuously enlarged at the base ..... 4. *Vesper montanus*
1. Fruiting peduncles equalling or longer than the leaves; mericarp wings not conspicuously enlarged at the base.
  2. Involucel bractlets with lacerate-fringed distal margins ..... 3. *Vesper macrorhizus*
  2. Involucel bractlets with entire or irregularly toothed or lobed margins.
    3. Involucre mostly a low hyaline sheath; involucel bractlets commonly purplish to rosy, 5–8-nerved; pedicels 0–1 mm long ..... 5. *Vesper multinervatus*
    3. Involucre of 1–8, oblong to obovate, often variously lobed bracts; involucel bracts greenish white to white, 1–3(–5)-nerved; pedicels 1–12 mm long.
      4. Umbels in fruit tightly globose, rays 1–4(–8) mm long, pedicels 1–4 mm long; carpophores absent; fruit orbicular, 10–12 mm long ..... 6. *Vesper purpurascens*
      4. Umbels in fruit relatively open, more or less flat-topped, rays 10–50 mm long, pedicels 5–12 mm long; carpophores well-developed; fruit oblong, 8 mm long.
        5. Involucel bractlets connate for 1/3–2/3 or more of length, the free portion usually abruptly enlarged distally, broadly ovate to orbicular, with mostly 1 vein, occasionally with 1–2 pairs of shorter lateral veins, parallel to divergent or branched ..... 1. *Vesper bulbosus*
        5. Involucel bractlets connate to 1/3 of length, the free portion gradually expanding distally, obovate to spatulate, with mostly 3 veins arising from the base, parallel below, gradually flaring distally, equal or nearly so ..... 2. *Vesper constancei*

1. *Vesper bulbosus* (A. Nelson) R.L. Hartman & G.L. Nesom, **comb. nov.** *Cymopterus bulbosus* A. Nelson, Bull. Torrey Bot. Club 26: 241. 1899. *Phellopterus bulbosus* (A. Nelson) Coulter & Rose, Contr. U.S. Natl. Herb. 7: 168. 1900. TYPE: USA. Wyoming. [Sweetwater Co.]: Green River, 14 Jun 1898, A. Nelson 4709 (holotype: RM digital image!; isotype: MO digital image!, US digital image!).

*Cymopterus utahensis* var. *eastwoodiae* M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 685. 1895. *Phellopterus purpurascens* var. *eastwoodiae* (M.E. Jones) Coulter & Rose, Contr. U.S. Natl. Herb. 7: 169. 1900. TYPE: USA. Colorado. La Plata Co.: Durango, no date, A. Eastwood s.n. (holotype: CAS digital image!; isotypes: COLO (mixture of *C. bulbosus* with a few branches of *C. constancei*), GH, US digital image!).

Plants acaulescent, tufted, weakly or not aromatic; taproot 8–20 or more cm long, 0.8–4 cm in diameter, enlarged variously, especially towards base. STEMS: pseudoscares usually 1 or 2, often conspicuous, each arising 1–7 cm below ground (1–10 cm long) among remnants of old leaf sheaths and often 1–2 leaves; scarios sheaths 1–3. LEAVES somewhat fleshy, thus often minutely wrinkled on drying, glabrous or margins rarely scaberrulous, not viscid, glaucous; petioles 1–8 cm long; blades lanceolate to broadly ovate in outline, 2–8 cm long, 1.5–5 cm wide, pinnate-pinnatifid to bipinnate-pinnatifid below, with 3–6 usually opposite pairs of lateral leaflets, leaflets sessile to petiolulate with distinct midribs, ultimate leaf segments 0.3–5 mm long, mostly 0.1–2.5 mm wide, oblong to elliptic, often overlapping, terminal leaflet variously pinnatifid to pinnate-pinnatifid into oblong to elliptic segments, apices rounded to apiculate. INFLORESCENCE of 1–8 or more umbels, in fruit loose to somewhat congested, rounded, 1–5 cm wide; peduncles 3–15 cm, in fruit equalling or longer than the

leaves, glabrous; involucre of 6–8 bracts 3–10 mm long, bracts ovate to broadly so, often fused into a cup, white, scarious with 1 green to brown vein; rays 5–9, 2–10 mm long, to 35 mm long in fruit; involucre of 6–8 bractlets, ovate to orbicular, usually rounded and notched, 4–6 mm long, fused in lower 30–70%, white, scarious with usually 1 green nerves arising from base, or with 1 or 2 pair of shorter lateral veins, parallel to divergent or branched, margin entire; pedicels 1–3 mm long, to 10 mm long in fruit. **FLOWERS** with calyx teeth 0.2–0.6 mm long or obsolete, lanceolate to ovate; petals white or cream to purple; styles 1.5–2 mm long; anthers cream to dark purple, outer umbels of staminate flowers, the inner of pistillate or some staminate flowers. **FRUIT** 6–11 mm long, broadly elliptic to oblong, tan to purplish, wings usually 5, 2–4 mm high, usually straight, smooth, membranous, not conspicuously enlarged at the base; oil tubes 3–4 per interval, 4–7 on commissure; carpophore bifid to base.

Flowering April to early May. Gumbo or clay flats, slopes, and badlands; 1340–2590 m; Arizona, Colorado, New Mexico, Texas, Utah, Wyoming.

2. ***Vesper constancei*** (R.L. Hartman) R.L. Hartman & G.L. Nesom, **comb. nov.** *Cymopterus constancei* R.L. Hartman, *Brittonia* 52: 136, figs. 1–2. 2000. **TYPE:** USA. Wyoming. Lincoln Co.: US. Hwy 189, 1.5 mi SW of Diamondville, rolling plains, with *Artemisia*, *Atriplex*, etc., 7000 ft, 11 May 1981, R.L. Hartman 125222 (holotype: RM!; isotypes: BRY!, COLO!, GHI!, KANU!, MO! digital image!, NY! digital image!, UC!, UNM!).

Plants acaulescent, tufted, weakly or not aromatic; taproot 3–11 or more cm long, 0.4–2 cm in diameter, enlarged towards base. **STEMS:** pseudoscapules usually 1–3, conspicuous, each arising 2–10 cm below ground (3–18 cm long) among remnants of old leaf sheaths and 1 or 2 leaves; scarious sheaths 1–3. **LEAVES** somewhat fleshy, thus often minutely wrinkled on drying, usually glabrous or margins sometimes scaberrulous, not viscid, often glaucous; petioles 5–10 cm long; blades lanceolate to broadly ovate in outline, 2.5–8 cm long, 1.5–3 cm wide, bipinnate-pinnatifid to tripinnate below, with 3–5 usually opposite pairs of lateral leaflets, leaflets sessile to petiolulate with distinct midribs, ultimate leaf segments 0.2–2.5 mm long, mostly 0.5–1 mm wide, oblong to elliptic, often overlapping, terminal leaflet variously pinnatifid to bipinnatifid into oblong to elliptic segments, apices round to obtuse or apiculate. **INFLORESCENCE** of 1–8 or more umbels, in fruit loose, convex to rounded, 2–5 cm wide; peduncle 1–12 cm, in fruit equalling or longer than the leaves, glabrous; involucre of 1–8 bracts 4–10 mm long, bracts oblong to obovate, often variously lobed, white, scarious with 1–4 purple veins; rays 3–6, 3–5 mm long, to 30 mm long in fruit; involucre of 4–6 bractlets, obovate to spatulate, broadly rounded to truncate, sometimes cleft, 4.5–7 mm long, fused in lower 20–30%, white, scarious with usually 3 dark green to purple nerves arising from base, parallel below, gradually flaring distally, equal or nearly so or lateral pair somewhat shorter, margin entire or irregularly toothed or lobed; pedicels 1–3 mm long, to 12 mm long in fruit. **FLOWERS** with calyx teeth 0.2–0.7 mm long or obsolete, triangular to ovate; petals white or cream to purple; styles 2–3 mm long; anthers purple. **FRUIT** 7–14 mm long, broadly elliptic to suborbicular, tan to purplish, wings 4–5, mostly 3–4 mm high, usually straight, smooth, membranous, not conspicuously enlarged at the base; oil tubes 2–3 per interval, 4–7 on commissure; carpophore bifid to base.

Flowering early February to late April. Sandy to loamy soils in shrublands and woodlands; 1260–2690 m; Arizona, Colorado, New Mexico, Utah, Wyoming.

*Cymopterus constancei* and *C. purpurascens* are similar in their involucre bractlets with 3–5 veins equal or nearly in length, parallel below but partly flaring above, with broadly rounded to truncate apices.

3. *Vesper macrorhizus* (Buckley) R.L. Hartman & G.L. Nesom, **comb. nov.** *Cymopterus macrorhizus* Buckley, Proc. Acad. Nat. Sci. Philadelphia 1861: 455. 1862. *Phellopterus macrorhizus* (Buckley) Coulter & Rose, Contr. U.S. Natl. Herb. 7: 167. 1900. **TYPE: USA. Texas.** Prairies, N of Austin, Mar 1860, *S.B. Buckley s.n.* (holotype: PH digital image!).

*Cymopterus montanus* var. *pedunculatus* M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 686. 1895.

**LECTOTYPE** (designated here): **USA. Texas.** [Dallas Co.:] Dallas, rocky prairies, "Mar, Apr" 1880, *J. Reverchon 1031* (US digital image!).

Jones (p. 687) noted that "The types of this variety are Woolson's specimen from Dallas, Texas; Reverchon's, same locality, with narrower wings." At US, these are *G.C. Woolson 96* from 1873 and *J. Reverchon 160* from Mar 1880.

Plants acaulescent, tufted, weakly or not aromatic; taproot 2.5–7 cm long, 1–3(–5) cm in diameter, enlarged variously, subglobose to fusiform. **STEMS:** pseudoscapae usually 1–3, usually conspicuous, each arising 3–10 cm below ground (3–8 cm long) among remnants of old leaf sheaths; scarious sheaths 1–4. **LEAVES** somewhat fleshy, thus often minutely wrinkled on drying, glabrous or margins usually scaberrulous or roughened, not viscid, usually glaucous; petioles 0.5–10 cm long; blades lanceolate to broadly ovate in outline, 2–5(–8) cm long, 1.5–3(–5) cm wide, pinnate-pinnatifid to bipinnate-pinnatifid below, with 3–6 usually opposite pairs of lateral leaflets, leaflets sessile or nearly so with distinct midribs, ultimate leaf segments 0.5–2 mm long, mostly 0.5–1.5 mm wide, oblong to ovate, often overlapping, terminal leaflet variously pinnatifid to pinnate-pinnatifid into oblong to spatulate segments, apices rounded to apiculate. **INFLORESCENCE** of 1–4 umbels, in fruit loose to somewhat congested, rounded, 1–4 cm wide; peduncles 2–20 cm, in fruit equalling or longer than the leaves, glabrous to papillate roughened, especially distally; involucre usually of 1–4 bracts (scarious with green vein) ca. 1 mm, distinct, sometimes absent; rays 5–14(–18), 4–11 mm long, to 30 mm long in fruit, often papillate-roughened; involucre of 2–4 bractlets, primary bracts ovate to broadly spatulate or widely obtusulate, 2.5–6 mm long, usually distinct, white, broadly scarious usually with a green patch in lower 1/3–1/2 with nerves highly branched (or reticulate) proximally and extending apically (veins 10–16, often very unequal in length, usually nearly parallel), contrasted against the scarious margin, smaller ones often with a ovoid patch of green (in fruit nerves prominent, often brown or purple), margin lacerate-fringed distally; pedicels 0.5–1 mm long, to 3 mm in fruit. **FLOWERS** with calyx teeth 0.2–0.4 mm long or obsolete, lanceolate to ovate; petals white; styles 1–1.5 mm long; anthers purple to purple-black. **FRUIT** 4.5–7 mm long, broadly elliptic to oblong, tan to purplish, wings usually 5, 1.5–2 mm high, usually straight, smooth, membranous, not conspicuously enlarged at the base; oil tubes 3–4 per interval, 6 on commissure; carpophore bifid to base.

Flowering mid March to early April. Chalk slopes, limestone ridges and hillsides, limestone gravel and silt, red clay, gypsum exposures, rocky and sandy prairies, mesquite-grassland, sandy roadsides; 200–700 m; New Mexico, Oklahoma, Texas.

4. *Vesper montanus* (Nutt. in Torr. & A. Gray) R.L. Hartman & G.L. Nesom, **comb. nov.** *Cymopterus montanus* Nutt. in Torr. & A. Gray, Fl. N. Amer. 1: 624. 1840. **TYPE: USA.** [protologue: "High bare plains of the Platte, toward the Rocky Mountains"], Platte plains, Rocky Mts, *T. Nuttall s.n.* (holotype: BM digital image!; isotypes: K digital image!, NY digital image!).

*Cymopterus campestris* Nutt. in Torr. & Gray, Fl. N. Amer. 1: 624. 1840. **TYPE: USA.** [protologue: "Plains of the Platte, near the Rocky Mountains"], "Rocky Mts., in places inundated in Winter," *T. Nuttall s.n.* (holotype: BM digital image!; isotype: GH).

*Phellopterus camporum* Rydb., Bull. Torrey Bot. Club 31: 574. 1904. **TYPE: USA. Colorado.** [Pueblo Co.:] Mesas near Pueblo, 14 May 1900, *P.A. Rydberg* and *F.K. Vreeland 5825* (holotype: NY digital image!; isotype: US digital image!).

In the protologue, Rydberg cited "*Rydberg and Vreeland 5825* (type, in flower) and 5824 (in fruit)."

*Phellopterus macrocarpus* Osterh., *Muhlenbergia* 6: 59. 1910. TYPE: USA. Colorado. Bent Co.: Las Animas, 16 Jun 1909 and 16 Apr 1910, G.E. Osterhout 3906 (holotype: NY digital image!).

PLANTS acaulescent, tufted, weakly or not aromatic; taproot 7–14 or more cm long, 0.8–3 cm in diameter, enlarged variously, especially towards base (often rounded). STEMS: pseudoscape usually 3–7, congested, each arising 1–2 cm below ground (0.5–6 cm long) among remnants of old leaf sheaths; scariosus sheaths 1–4. LEAVES somewhat fleshy, thus often minutely wrinkled on drying, scaberulous on margins and often leaves, not viscid, usually glaucous.; petioles 0.5–5(–8) cm long; blades narrowly to broadly ovate in outline, 3–8.5 cm long, 2–5.5 cm wide, mostly pinnate-pinnatifid, rarely bipinnate-pinnatifid below, with 4–5 usually opposite pairs of lateral leaflets, leaflets sessile, rarely petiolulate with distinct midribs, ultimate leaf segments 1–4 mm long, mostly 0.5–1.5 mm wide, ovate to oblong, mostly overlapping, terminal leaflet variously pinnatifid into oblong to elliptic segments, apices generally apiculate. INFLORESCENCE of 3–7 or more umbels, in fruit congested, occasional loose, rounded, 1–3 cm wide; peduncles 1–4(–9) cm, in fruit shorter than or equalling the leaves, scaberulous; involucre of rudimentary, bracts or two to four to 2–4(–9) mm long, oblong to obovate, often white to purple rays 5–9, 3–10 mm long, lengthening little in fruit; involucre of 5–7 bractlets, lanceolate to elliptic to broadly orbicular, apiculate to notched, 2–3(–4) mm long, distinct or nearly so, central patch green, lanceolate with lateral nerves decreasing in length laterally, scariosus margins equal to 2x width of patch, margin entire; pedicels 1–2 mm long, lengthening little in fruit. FLOWERS with calyx teeth 0.1–0.2 mm long or obsolete, triangular to oboate, petals white to purple; styles 2–2.5 mm long; anthers purplish. FRUIT 18–23 mm long, broadly elliptic to oblong, tan to purplish wings 5, 4–5 mm high, straight to wavy, smooth, membranous, conspicuously enlarged at the base; oil tubes 3–4 per interval, 4–6 on commissure; carpophore absent. Plants in the vicinity of Pueblo, Colorado, are robust with long pedicels and were mistakenly identified by Mathias as *Cymopterus bulbosus*.

Flowering April to early May. Grassland plains and hillsides in sandy or sandy loam; 900–2250 m; South Dakota, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, Texas, Wyoming.

5. *Vesper multinervatus* (Coulter & Rose) R.L. Hartman & G.L. Nesom, **comb. nov.** *Phellopterus multinervatus* Coulter & Rose, Contr. U.S. Natl. Herb. 7: 169. 1900. *Cymopterus multinervatus* (Coulter & Rose) Tidest., Proc. Biol. Soc. Wash. 48: 41. 1935. TYPE: USA. Arizona. [Mohave Co.:] Peach Springs, May 1884, J.G. Lemmon s.n. (holotype: US digital image!).

PLANTS acaulescent, tufted, weakly or not aromatic; taproot 8–15 or more cm long, 0.8–3.5 or more cm in diameter, enlarged variously, especially towards base (often rounded). STEMS: pseudoscares usually 1 or 2, often conspicuous, each arising 1–7 cm below ground (1–10 cm long) among remnants of old leaf sheaths; scariosus sheaths 1–3. LEAVES somewhat fleshy, thus often minutely wrinkled on drying, glabrous or margins rarely roughened, not viscid, dull green to glaucous; petioles 1–8 cm long; blades broadly ovate to triangular in outline, 2–10 cm long, 1.5–9 cm wide, pinnate-pinnatifid to bipinnate-pinnatifid below, with 3–6 usually opposite pairs of lateral leaflets, leaflets sessile to petiolulate (petiolules to 1.5 mm long) with distinct midribs, ultimate leaf segments 0.2–5 mm long, mostly 0.1–2 mm wide, oblong to elliptic, frequently not overlapping, terminal leaflet variously pinnatifid to pinnate-pinnatifid into oblong to elliptic segments, apices generally rounded (margins and apices curved adaxially). INFLORESCENCE of 1–6 or more umbels, in fruit loose to somewhat congested, rounded, 2–5 cm wide; peduncles 6–18 cm, in fruit equalling or longer than the leaves, glabrous; involucre of rudimentary, often a collar, or with one or two bracts to

0.8 mm long, oblong to obovate, white to purple, scarious with several near parallel veins; rays 7–19, 3–10 mm long, lengthening little in fruit; involucre of 5–8 bractlets, obovoid to orbicular, usually apically rounded, 7–9 mm long, fused in lower 40–65%, mostly purple when mature, scarious margin thin to 1/4 width of fruit, nerves 5–9 or more, primarily parallel, often branched but then branches closely parallel, extending the full length of bractlets, margin entire or distally notched or apiculate; pedicels 1–3 mm long, some lengthening to 6 mm in fruit. **FLOWERS** with calyx teeth 0.2–0.4 mm long or obsolete, rounded; petals white to purplish; styles 2–2.5; anthers purple. **FRUIT** 18–23 mm long, broadly elliptic, tan to purplish, wings usually 5, 4–5 mm high, usually straight, smooth, membranous, not conspicuously enlarged at the base; oil tubes 3 in intervals, 5–6 on commissure; carpophore absent.

Flowering mid March to early April. Shrublands and woodlands often on sand or loam of rolling plains; 850–1830 m; Arizona, California, Nevada, Utah; n. Mexico.

6. *Vesper purpurascens* (A. Gray) R.L. Hartman & G.L. Nesom, **comb. nov.** *Cymopterus montanus* var. *purpurascens* A. Gray, Rep. Colorado River 4: 15. 1861. *Cymopterus purpurascens* (A. Gray) M.E. Jones, Zoë 4: 277. 1893. *Phellopterus purpurascens* (A. Gray) Coulter & Rose, Contr. U.S. Natl. Herb. 7: 168. 1900. **LECTOTYPE** (designated here): **USA. Arizona.** [Coconino Co.: San Francisco Mountains, no date, *J.S. Newberry*?] *s.n.* (GH).

In the protologue, Gray noted "Stony hill-sides. Yampai valley (Camp 64; March 28) to San Francisco mountain, New Mexico. ... Oryabe, New Mexico." A specimen at NY is annotated as "isotype:" 1858, Newberry in Ives Colorado [???] (NY digital image!).

*Cymopterus utahensis* M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 684. 1895. *Phellopterus utahensis* (M.E. Jones) Wooton & Standl., Contr. U.S. Natl. Herb. 16: 158. 1913. **TYPE:** **USA.** On page 684, Jones cited data for the Arizona collections *Jones 5098* (US digital image!), *Jones 5098h* (US digital image!), and *Jones 5098p* (US digital image!), but he noted (p. 685) that "This is No. 1685 of my Utah collection, and abounds on the clayey and gravelly plains, valleys and lower hillsides throughout Utah and Nevada."

*Cymopterus utahensis* var. *monocephalus* M.E. Jones, Proc. Calif. Acad. Sci., ser. 2, 5: 685. 1895. **TYPE:** **USA. Utah.** [Tooele Co.?] Terminus, Jun-May 1890, *M.E. Jones s.n.* (isotype: MO digital image!).

*Phellopterus filicinus* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 158. 1913. **TYPE:** **USA. New Mexico.** Grant Co.: Bear Mountain near Silver City, 17 Jun 1903, *O.B. Metcalfe 165* (holotype: US digital image!).

Plants acaulescent, tufted, weakly or not aromatic; taproot 5–18 or more cm long, 0.3–3 or more cm in diameter, enlarging variously, especially towards base. **STEMS:** pseudoscares 1 or 2, sometimes conspicuous, each arising 1–5 cm below ground (1–7 cm long) among remnants of old leaf sheaths and often 1 to 5 leaves; scarious sheaths 1–3. **LEAVES** somewhat fleshy, thus often minutely wrinkled on drying, glabrous or margins rarely scaberrulous, not viscid, glaucous; petioles 1–7 cm long, blades lanceolate to broadly ovate in outline, 1.2–7 cm long, 1.5–5 cm wide, pinnate-pinnatifid to bipinnate-pinnatifid below, with 3–6 opposite pairs of lateral leaflets, leaflets sessile to petiolulate with distinct midribs, ultimate leaf segments 0.1–5 mm long, mostly 0.1–2.8 mm wide, oblong to elliptic, often overlapping, terminal leaflet variously pinnatifid to bipinnatifid into lanceolate to ovate segments, apices mostly rounded. **INFLORESCENCE** of 1–8 or more yet obscurely distinct umbels, in fruit congested, usually globose, mostly 3–6 cm wide; peduncles 2–14 cm, in fruit equalling or longer than the leaves, glabrous; involucre usually of 8–10 bracts 8–15 mm long, bracts fused into a lobed to variously parted cup, white, scarious with 1–4 purple veins; rays 0–8, 1–8 mm long, lengthening little in fruit; involucre of 4–6 bractlets, often obscured by the involucre or fruit, oblong to elliptic, usually rounded, 4–7 mm long, fused in lower 30–60%, white, scarious with 1–4 dark green to purple nerves arising from base, equal or lateral veins to half as long, margin entire;

pedicels 0–5 mm long, lengthening little in fruit. FLOWERS with calyx teeth 0.2–0.5 mm long, lanceolate to rounded; petals white or purplish; styles 1.5–2 mm long; anthers purple. FRUIT 7–15 mm long, broadly elliptic to suborbicular, tan to purplish, wings 5, 2–4 mm high, straight to wavy, smooth, membranous, not conspicuously enlarged at the base; oil tubes 3–4 per interval, 4–7 on commissure; carpophore absent.

Flowering mid March to early June. Shrubland and woodland on sand or loam; 1300–2740 m; Arizona, California, Idaho, and Utah.

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We are grateful to Al Schneider for permission to use the color photos of *Vesper bulbosus* and *Vesper constancei*. These are from his website, "Wildflowers, ferns, and trees of Colorado, New Mexico, Arizona, and Utah" (<http://www.swcoloradowildflowers.com/>), which has hundreds of photos and much related information on the flora of that region.

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## NON-NATIVE SPECIES NEW TO TEXAS WITH COMMENTS ON OTHER SPECIES

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### ABSTRACT

Two non-native plant species are first reported here as growing outside of cultivation in Harris Co., Texas, and are additions to the non-native flora of Texas. *Gilia tricolor* has been introduced as a wildflower along the ditches in parts of the Westchase area of Houston and *Macroptilium lathyroides* has been found growing in landscapes in association with nursery plants originating in Florida. *Ludwigia peruviana* has been found naturalized in the Houston area, only the second county record from Texas. *Manihot grahamii*, previously misidentified as *M. esculenta*, also is a naturalized species in southeast Texas, documented here from Hardin and Harris counties.

*Gilia tricolor* Benth. (Polemoniaceae) was a very common wildflower species in a ditch near the Westchase area of Houston, apparently growing from seeds sown in late 2009. The site was visited the next two years and seedlings were observed, but it was not visited again to see if the plants were flowering. The species is native to California and also known to be naturalized in Colorado and Massachusetts (BONAP 2012). There are no *Gilia* species known from southeast Texas (Correll & Johnston 1970; Hatch et al. 1990). This species is characterized by its tricolor corolla; yellow with purple spots below the blue-violets lobes (Fig. 1). It is the first member of Polemoniaceae to be added to the list of non-native plants of Texas (Nesom et al. 2010; Aplaca 2010).

Harris Co. Houston, Westchase area, growing alongside ditch behind the Robinson Library all the way to and past Walnut Bend, Key Map 489Y, with *Lupinus*, *Bromus*, *Lolium*, *Phlox*, all possibly seeded, 19 Apr 2010, *Aplaca 790* (SBSC, SWT).

*Macroptilium lathyroides* (L.) Urb. (Fabaceae) (wild bushbean) is growing prolifically in a library landscape in West Houston. The plants have been observed freezing back to the ground in the winter of 2010-11 and new plants sprouted in the summer of 2011. These plants were not planted in the landscape; therefore the seeds must have arrived in the soil on the landscaped plants. This species is native to tropical America and is naturalized in Florida, Georgia, Louisiana, and South Carolina (USDA, NRCS 2012). Many of the landscape plants originated in Florida (pers. comm., K. Asakura, Asakura-Robinson Landscaping), where the seeds were probably stowaways in the soil. Landscape maintenance has tried to control this plant by hand removal but it readily reseeds.

Wild bushbean is a twining herbaceous annual up to 1.5 meters (Fig. 2). The flowers are scarlet to purple red with a spirally twisted keel and the legume is linear, straight and mostly 8-12 cm long, ca. 3 mm wide (Fig. 3). The spiraled leaves are pinnate trifoliate, leaflets ovate or elliptical, 2-4 cm long and 1.5-3.5 cm wide. The individuals in this population showed variety between ovate and elliptical leaflets. The landscape maintenance has tried to control this plant, but it readily reseeds.

Harris Co. Houston, growing in the landscape of the new Kendall Library/Community Center on Eldridge Pkwy just N of Buffalo Bayou, large plants ascending and twining through other vegetation, Key Map 488G, growing near the bases of various grasses and *Crimum* in the landscape, obviously an introduction from nursery contamination, 6 Aug 2010, *Aplaca 832* (SBSC, SWT).





Figure 1. *Gilia tricolor* in Harris County.



Figure 2 *Macropitium lathyroides* stem, leaves, and inflorescence



Figure 3 *Macropitium lathyroides* flowers and fruit

**Ludwigia peruviana** (L.) H. Hara (Onagraceae) (Peruvian primrose-willow) is a woody species that has previously only been recorded from Terrell County in west Texas (Ramamoorthy & Zardini 1987). In 2008 the author found a population thriving in a wetland area of Hermann Park in Houston. There were several shrubs about 2.5 m tall and the plants were observed spreading over the following several years. This is the first record in Texas outside the single collection from Terrell County. The area of Hermann Park is generally left to grow naturally with little maintenance by the park staff. There has been no attempt to control these plants, but concerns about potential invasiveness have been brought up to the Hermann Park Conservancy and the Houston Parks Department.

Harris Co. Houston, Hermann Park, Growing at water's edge on swampy part of McGovern Lake, 23 Aug 2008, Aplaca 599 (SWT).



Figure 4. *Ludwigia peruviana* flower and immature capsule.



Figure 5. *Ludwigia peruviana* growth habit of an individual 15 meters from the original population

***Manihot grahamii* Hook.** (Euphorbiaceae) (Graham's manihot) was collected from sites in Hardin and Harris counties. Many of these vouchers were previously identified as *M. esculenta* Crantz and have been correctly annotated by (pers. comm., Dr J Hayden, University of Richmond). The earliest voucher reports this species as cultivated at the Houston Arboretum in Harris County in 1976. It has been reported from Florida, Georgia, and Louisiana (USDA, NRCS 2012, BONAP 2012) but not previously from Texas. The vouchers cited here apparently have been the basis for attributions of *M. esculenta* to the Texas flora.

*Manihot grahamii* is a South American species that is known to be more cold tolerant than others. The plants become small trees in understory areas and spread regularly from seed and vegetative growth. The area in Harris County has been observed for about a year and a half — the plants are behind the city greenhouse spreading into the forested areas of Memorial Park. The extent of the invasiveness of this species is not known yet, but when the area was cleared of some of the larger individuals, seedlings and root sprouts were actively growing soon afterwards.



Figure 6 – *Manihot grahamii* individual in Memorial Park, Harris County

Hardin Co. near Evadale Bridge E of Silsbee and S of highway, ca 50 plants in garbage dump area W side of Neches River, seemingly well established in wild, 24 Aug 1983, *Johnston 12800* (TEX). Harris Co. Houston Arboretum, cultivated in Houston, 1976, *Vines s.n.* (SBSC), banks of Buffalo Bayou, across from Houston Arboretum, Houston, Apr 1976, *Anderson s.n.* (SBSC), Houston, plant grown from seed obtained in Mexico, fairly large tree in backyard flowerbed, 2.5-3" diameter trunk, 10231 Ivy Ridge, home of Mr. & Mrs. Doug Williams, 18 May 1992, *Tveten L-1498* (SBSC); tall shrub near Cypress Creek in Mercer Arboretum and Botanical Gardens along Aldine Westfield Rd, N of Hwy 1960 and on S side of Cypress Creek, N of Houston,

25 Oct 1997, *Brown 21668* (SBSC), Magnolia Gardens, 24 Oct 2002, *Johnson 1193* (SBSC), Houston, behind HPARD greenhouse at 6502 Memorial Drive, spreading into Memorial Park, 19 Jun 2009, *Aplaca 667* (SBSC)

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## SYNOPSIS OF AMERICAN *CARTREMA* (OLEACEAE)

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### ABSTRACT

*Cartrema* Raf. in the USA and Mexico includes two species: *Cartrema americana* (L.) Nesom, **comb. nov.**, and *Cartrema floridana* (Chapman) Nesom, **comb. nov.** (based on *Osmanthus floridanus* Chapman, an earlier name for *Osmanthus megacarpus* Small). *Cartrema americana* occurs in the eastern USA east of the Mississippi River and in Mexico, where it ranges more or less continuously in eastern states from Nuevo León south to Chiapas and in the western states of Sonora, Chihuahua, Durango, and Jalisco. Maps show the distribution in the USA and in Mexico. *Osmanthus americanus* var. *microphyllus* P.S. Green and *Osmanthus mexicanus* Lundell, both from Mexico, are treated here as synonyms of *C. americana*. *Cartrema floridana* is endemic to the Florida peninsula. All other taxa indicated by molecular and morphological data to belong in *Cartrema* are native to southeastern Asia.

**KEY WORDS:** *Cartrema*, *Osmanthus*, *Osmanthus* sect. *Leiolea*, Oleaceae

The species of *Osmanthus* with a paniculate inflorescence have long been recognized as distinct as a group from those with a fasciculate inflorescence. They were treated as sect. *Leiolea* within *Olea* by Spach (1839) and then within *Osmanthus* by Green (1958). Rafinesque (1838) placed them in the genus *Cartrema*; Small (1933) superfluously created the genus *Amarolea*. In view of accumulating evidence, Weakley et al. (2011) gave notice that the southeastern USA species will be treated within *Cartrema* in forthcoming state and regional floristic accounts, and that disposition is accepted here.

Molecular evidence (Guo et al. 2011) confirms that the species of *Osmanthus* sect. *Leiolea* comprise a monophyletic group. In addition to the American taxa, the group includes five additional species from southeastern Asia — this whole group is more closely related to two Asian species of *Olea* (sect. *Tetrapilus*) than to fasciculate-flowered *Osmanthus*.

The taxonomy of the native American plants of *Cartrema* Raf. (*Osmanthus* sect. *Leiolea*) is reviewed here. These plants extend southward though Mexico to southern Chiapas. Because of the proximity of the Chiapas localities, the Flora of Guatemala (Standley & Williams 1969) included *Osmanthus americanus* as a potential member of the flora, but apparently the species remains undocumented south of Mexico.

**CARTREMA** Rafinesque, Sylva Tell., 184. 1838. **TYPE:** *Olea americana* L. = *Pausia americana* (L.)

Raf. Rafinesque validated the genus name in 1838 but did not provide a nomenclatural combination for the single species he included (see comments below).

*Amarolea* Small, Man. S.E. Fl., 1043. 1933. *Osmanthus* subg. *Amarolea* (Small) Tzvelev, Novosti Sist. Vyssh. Rast. 34: 146. 2002. **LECTOTYPE** (Johnson 1957, p. 414): *Amarolea americana* (L.) Small ≡ *Olea americana* L. Small did not specify which of the two species of *Amarolea* (*A. americana*, *A. megacarpa*) was the type.

*Olea* sect. *Leiolea* Spach, Hist. Nat. Veg. Phan. 8: 266. 1839. *Osmanthus* sect. *Leiolea* (Spach) P.S. Green, Notes Roy. Bot. Gard. Edinburgh 22: 454. 1958. **TYPE:** *Olea americana* L. = *Osmanthus americanus* (L.) Benth. & Hook. f. ex A. Gray

*Osmanthus* sect. *Microsanthus* Nakai, Bot. Mag. Tokyo 44: 14. 1930. TYPE: *Osmanthus marginatus* (Champ. ex Benth.) Hemsl.

# KEY TO THE SPECIES

1. Mature drupes (dried) (6)–7–10(–11) mm; se USA and Mexico ..... 1. *Cartrema americana*
1. Mature drupes (dried) 18–25 mm; endemic to Florida ..... 2. *Cartrema floridana*

1. **CARTREMA FLORIDANA** (Chapman) Nesom, comb. nov. *Osmanthus floridanus* Chapman, Fl. South. U.S., ed. 2, Suppl. 2, 693. 1892. *Amarolea floridana* (Chapman) L.E. Arnold, J. Elisha Mitchell Sci. Soc. 52: 86. 1936. TYPE: USA. Florida: [Manatee Co.:] Manatee, [sandy pine barrens, without date, J.H.J. Simpson s.n. (holotype: US!, Fig. 1). The specimen has not been previously noted as a type, but the label apparently is in Chapman's hand. EPITYPE (designated here): USA. Florida: Highlands Co.: Ca. 0.4 mi N of main ranch road at a point ca. 1.4 mi E of US 27 at a point ca. 1.6 mi S of Bald Hill and ca. 7.3 mi S of Bairs Den, ca. 3.4 air mi NE of Venus, Hendrie Ranch, extensive rolling rosemary-scrub oak bald on white sand, dominated by *Ceratiola-Quercus inopina-Q. geminata-Q. chapmanii-Sabal etonia-Serenia repens*, soils - St. Lucie (Typic Quartzipsamments), 90–130 ft, 9 Nov 1990, S.L. Orzell 15813 with E.L. Bridges (USF digital image!).  
*Amarolea megacarpa* Small, Man. S.E. Fl., 1043, 1507, 1933. *Osmanthus megacarpus* (Small) Small ex Little, J. Wash. Acad. Sci. 33: 10. 1943. *Osmanthus americanus* var. *megacarpus* (Small) P.S. Green, Notes Roy. Bot. Gard. Edinburgh 22: 462. 1958. *Osmanthus americanus* subsp. *megacarpus* (Small) E. Murray, Kalmia 13: 10. 1983. *Cartrema megacarpa* (Small) Weakley, J. Bot. Res. Inst. Texas 5: 445. 2011. TYPE: USA. Florida. Highlands Co.: Sandhills near Lake Annie, 8 Jan 1925, J.K. Small & P. Mattheus 11612 (holotype: NY digital image!; isotypes: GH, US digital image!).

**Shrubs**, (1)–2–3(–4) m, occasionally characterized as a "small tree." Stems: usually 2 or more from the base, sometimes branching near the ground, rarely with a single axis; bark gray-brown to light gray or silvery, smooth, becoming finely scaly. Leaves persistent, elliptic to elliptic-oblongate or oblanceolate, 5.5–12 cm x 20–40(–50) mm, base cuneate to attenuate, margins entire, revolute, apex acute to short-acuminate or obtuse, glabrous on both surfaces; petioles 3–10 mm. Inflorescences axillary, 12–20-flowered. Pedicels 0–1 mm. Flowers unisexual or rarely bisexual; corolla white to yellow, tube 2–3 mm, lobes 1.5–2.5 mm, ca. equal tube length, plane to loosely involute. Drupes dark bluish purple to nearly black, subglobose to broadly ellipsoid or ellipsoid-obovate, 18–25 mm at maturity (dried).

Flowering Feb–May. Sand pine scrub, oak scrub, rosemary balds, dry oak hammocks, turkey oak barrens; 10–100 m; Florida (Map 1).

Floridians have most often treated *Cartrema floridana* at specific rank (for example, using the epithet "megacarpa," Huck et al. 1989; Christman & Judd 1990; Wunderlin & Hansen 2011). Nelson (1994, 1996) was equivocal, observing that it might be regarded either as a species or as a variety of *Osmanthus americanus*, but he later (2010) accepted it at specific rank. Green (1958) treated it at varietal rank, noting that various literature descriptions have given measurements of fruit size that could be interpreted as intermediate. Thus, except for the ambiguity regarding rank, there has been no reluctance in recognizing the existence of the large-fruited entity.





Figure 1. Holotype of *Osmanthus floridanus* Chapman (US). The specimen has not been previously recorded as a type but the label apparently is in Chapman's hand. The label reads "Osmanthus floridanus Chapm., Simpson, Manatee, Florida."



The protologue of *Osmanthus floridanus* in its entirety is this: "Inflorescence more or less pubescent; style sigmoid; stigma nearly as broad as the ovary; drupe ovoid, yellowish-green, 8"-9" long. Otherwise like *O. americanus*. — Sandy pine barrens, Manatee, South Florida. (*J. H. Simpson*). — A low shrub." This was essentially repeated in the third edition of Chapman's *Flora* (1897, p. 352). As noted by Chapman in his "Signs Used In This Work" (1889, p. xxvi), he used the double quotation mark to denote measurement of a "line" (= 1/12 of an inch). The equivalents of 8-9 lines are 8 1/2-9 1/2 inch = 0.67-0.75 inch = 17-19 mm. Thus Chapman described drupes characteristic of the large-fruited *Osmanthus* as well as its characteristic habitat. His characterization of the fruits as yellowish-green indicates that they were immature.

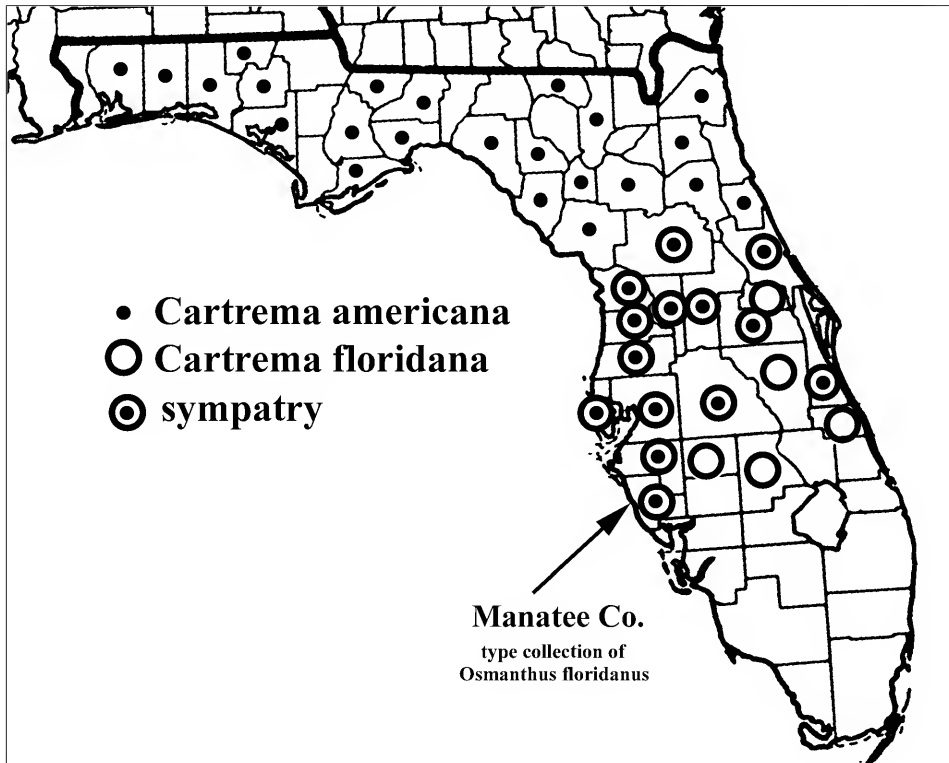
Small included *Osmanthus floridanus* in his "Flora" (1903, 1913), describing it with "drupe yellowish-green, 16-20 mm long," the color and fruit measurements presumably reflecting Chapman's original description. The contrast in fruit size with *O. americanus* was shown by Small in the descriptions but not in the key. For his "Manual" (Small 1933), he had decided that *O. floridanus* was not correctly applied, or perhaps not unambiguously applied, to the large-fruited plants and published the name *Amarolea megacarpa*, treating it along with *A. americana* to constitute the new genus *Amarolea*. *Osmanthus floridanus* was placed in synonymy of *Amarolea americana* and the fruit dimensions for *Amarolea megacarpa* were modified to "2-2.5 cm long" (description)/ "2-2.5 cm in diameter" (key); fruit dimensions for *Amarolea americana* were "10-15 mm long" (description)/ "1 cm in diameter or less" (key).

It is clear, as formalized in the nomenclature here, that Chapman's name was the first to apply to the large-fruited species. The holotype (Fig. 1) is from a plant in flower — designation of an epitype, a specimen with mature fruits, is intended to provide clarity in application of the name.

The large fruit size of *Cartrema floridana* is the single known morphological feature of distinction from *C. americana*, but the difference is striking. Unequivocal identifications are best made during fruit maturity, which is generally mid-August through October and November, but developing fruits that already exceed the size range of *C. americana* support a confident identification.

Fruit size for typical *Cartrema americana* was first determined in the present study by measuring mature fruits from USA localities outside of Florida. The county-level distribution of *C. americana* in Florida (Map 2) was assessed by recording only collections with mature fruits (collected mid-August through fall) — fruits of these plants all were within the measurement range determined from the USA outside of Florida. Similarly, sizes for *C. floridana* were measured only from presumably mature fruits (see Table 2). The only exception is for Manatee County (whence the type of *Osmanthus floridanus*), where documentation of *C. americana* is based on a sterile collection from a wet habitat: "Bay-head," 27 Apr 1917, *Cuthbert 1452* (FLAS-3 sheets). Several collections from Manatee County document the occurrence there of the large-fruited species in dry habitats.

Ecological differentiation between *Cartrema americana* and *C. floridana* is distinct — *C. americana* occurs in moist habitats while *C. floridana* is restricted to dry barrens, scrubs, and xeric hammocks. This difference is so consistent, with few exceptions, that it can be considered essentially diagnostic. In fact, a number of collections without mature fruits (e.g., USF; sterile, flowering, or with immature fruits) within the area of sympatry surely have been identified in both species on the basis of habitat. In any case, enough collections with mature fruit are available that Map 2 in the present study is a close match to the distributions shown by Wunderlin and Hansen (2012).



Map 1. County distribution of *Cartrema americana* and *C. floridana* in Florida. Symbols are placed only on the basis of unequivocal identification through fruit size (see text). Collections were studied first-hand at SMU-BRIT-VDB and TEX-LL; collections from FLAS, FTG, and USF were studied through digital images available through herbarium databases at high enough resolution to allow accurate measurements at millimeter level.

2. **CARTREMA AMERICANA (L.) Nesom, *comb. nov.*** *Olea americana* L., Mant. Pl. 1: 24. 1767. *Olea laeta* Salisb., Prodr. Stirp. Chap. Allerton, 13. 1796 [illegit. substitute name for *Olea americana* L.]. *Pausia americana* (L.) Raf., Sylva Tellur., 9. 1838. *Pausia odorata* Raf., Sylva Tellur., 9. 1838 [illegit. substitute name for *Olea americana* L.]. *Cartrema odorata* (Raf.) Raf., Autik. Bot., 16. 1840 [nom. illeg. superfl.]. *Osmanthus americanus* (L.) Benth. & Hook. f. ex A. Gray, Syn. Fl. N. Amer. 2(1): 78. 1878. *Amarolea americana* (L.) Small, Man. S.E. Fl., 1043. 1933. **LECTOTYPE** (Green 1958, p. 462): **USA. South Carolina.** "Habitat in Carolina." (LINN-20.6 digital image!).

Weakley et al. (2011) assumed that *Osmanthus* (*Olea*) *americana* had been transferred to *Cartrema* by Rafinesque (Sylva Telluriana, 184. 1838), but such is not the case. Rafinesque in 1838 provided *Cartrema* Raf. as a replacement name for *Pausia* Raf. (*Oleaceae*; non *Pausia* Raf., Fl. Tellur. 4: 105. 1836 [publ. 1838], Thymelaeaceae) but he made no mention on page 184 of any species. The very brief entry is at the bottom of the page, at the very end of the book index: "Correction—For *Pausia* 10 real *Cartrema* Raf. meaning perforate nut, having already another *G[enus] Pausia* in flora telluriana 1139."

The nomenclatural combination in *Cartrema* also has been cited as "Raf. ex B.D. Jackson, Index Kewensis 1: 445. 1893," but Jackson indicated there (p. 445) that the genus *Cartrema* Raf. is a

synonym of *Osmanthus*, and the only species in the entry (as [*Cartrema*] "*Americana* Raf.") is indicated to be a synonym of *Osmanthus americana*. Thus a valid combination was made neither by Rafinesque nor by Jackson.

*Osmanthus americanus* var. *microphyllus* P.S. Green, Notes Roy. Bot. Gard. Edinburgh 22: 463. 1958. TYPE: MEXICO. Nuevo León. Sierra Madre Oriental, San Francisco Cañon, about 15 mi SW of Pueblo Galeana, scattered shrub on tops of hills near mouth of cañon, 7500–8000 ft, 14 May 1934, C.H. Mueller 371 (holotype: NY digital image!; isotypes: A, MICH digital image!, TEX!).

*Osmanthus mexicanus* Lundell, Phytologia 1: 308. 1939. TYPE: MEXICO. Chiapas. Cerro ["Cero" on label] Laguna, Mapastepec, arbor 6–7 m, 25 cm diam., Jan 1938, E. Matuda 2023 (holotype: MICH digital image!; isotypes: A, F digital image!, GH, LL!, NY-3 sheets digital images!, US digital image!).

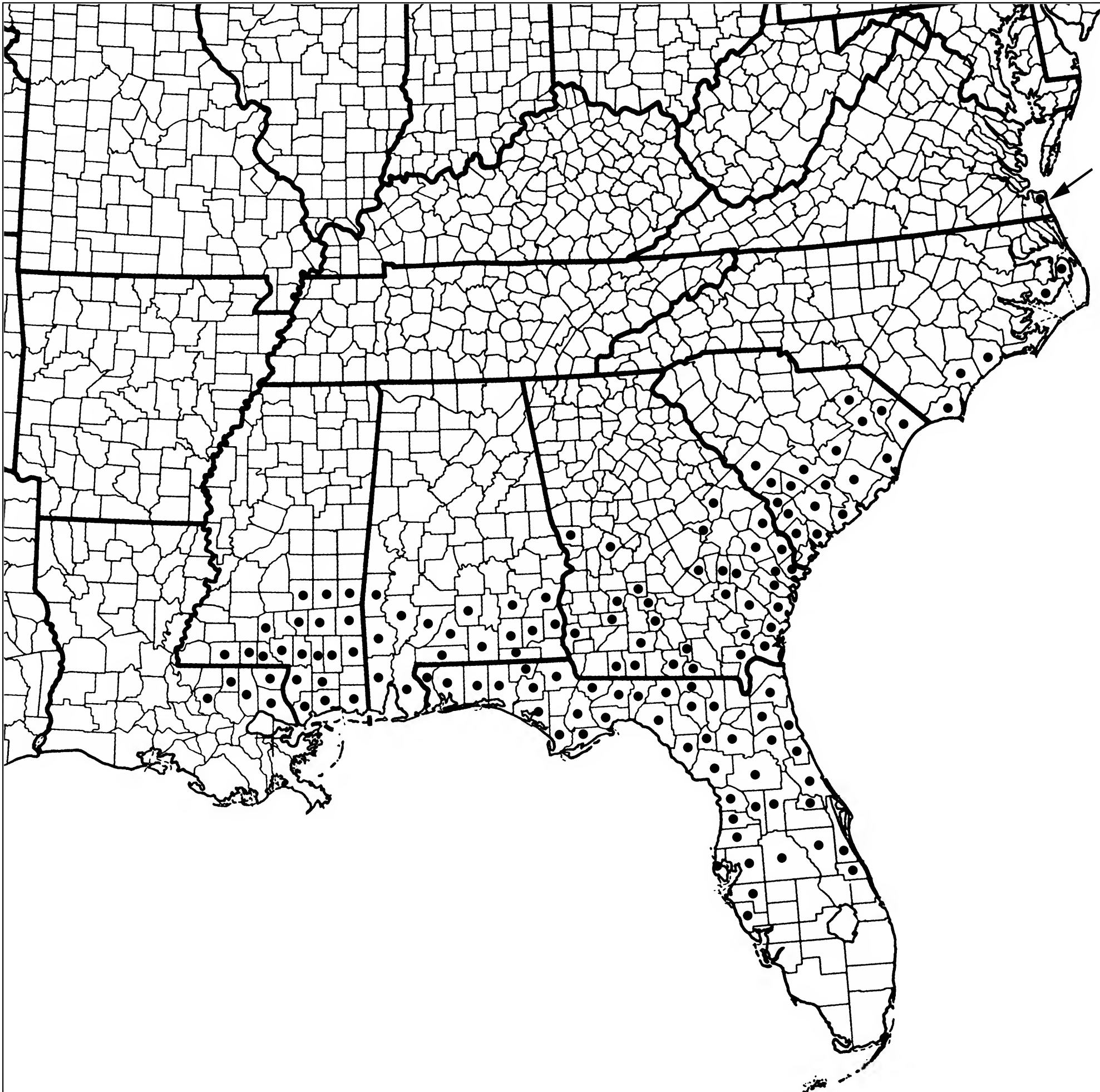
The F and NY isotypes were annotated as *Osmanthus americanus* by P.S. Green in 1989.

**Trees or shrubs.** 1.5–6(–10) m. **Stems:** trunk single or often branching near ground; bark gray-brown to light gray or silvery, smooth, becoming finely scaly. **Leaves** persistent or semi-persistent, elliptic or oblong-elliptic to oblanceolate or obovate, (5)–8–12(–15) cm x (15)–20–40(–50) mm, base cuneate, margins entire, revolute, apex acute or rarely short-acuminate, obtuse, rounded, or notched, glabrous on both surfaces; petioles (5)–10–15(–20) mm. **Inflorescences** axillary, 12–20-flowered. **Pedicels** 0–1 mm. **Flowers** unisexual or rarely bisexual; corolla white to yellow, tube 2–3 mm, lobes 1.5–2.5 mm, ca. equal tube length, plane to loosely involute. **Drupe**s dark bluish purple, globose to globose-ovoid or ellipsoid, (6)–7–10(–11) mm at maturity (dried). **2n** = 138.

**USA.** Flowering Feb–May. Creek, lake, swamp, and sinkhole margins, shell mounds, moist sand ridges, roadside thickets, mesic hardwoods, beech-magnolia, longleaf pine-bluejack oak savannas, upland mixed woods with *Persea*, live oak hammocks, hardwood floodplain forests, swamps (gum-white cedar, gum-magnolia-bay), pine flatwoods, evergreen scrub oak, sand pine and oak scrub; 0–150 m; Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Virginia. Map 2.

**Mexico.** Flowering Feb–Apr. stream sides, cliff bases, talus, steep banks and hill sides, limestone ridges, juniper matorral, oak, pine-juniper, and pine-oak woodland, mesophytic forests; 1000–2500 m; Chihuahua, Durango [fide Rzed. & Rzed. 2004], Guanajuato, Hidalgo, Jalisco, Nuevo León, Oaxaca, Puebla, Querétaro, San Luis Potosí [fide Rzed. & Rzed. 2004], Sonora, Tamaulipas, Veracruz. Map 3.

In the southeastern USA, *Cartrema americana* is a common tree of coastal hammocks and other moist sites of the Atlantic and Gulf coasts. The distribution ends in eastern Louisiana, skipping over the rest of Louisiana and Texas to reappear in northwestern Mexico. Texas was cited as part of the range of *Cartrema americana* by Hardin (1974) and this has been repeated in large databases (e.g., BONAP 2012; USDA, NRCS 2012). The basis for the Texas report perhaps is Cooper (1858, p. 253), where "Texas" is listed in a table of geography for *Olea americana*. No documentation for this record has been found, however, and the species is not known to occur natively in Texas. The westernmost part of the range in the USA is in northeastern Louisiana, where it is known from at least five mostly contiguous parishes. I have not seen a voucher for the record shown in Sabine Parish (Thomas & Allen 1998; BONAP 2012), disjunct to the west and on the Texas border, and it seems unlikely that the species occurs natively there. The northernmost record known for *C. americana* is from Virginia Beach County in the southwestern corner of Virginia (Virginia Botanical Associates 2012).

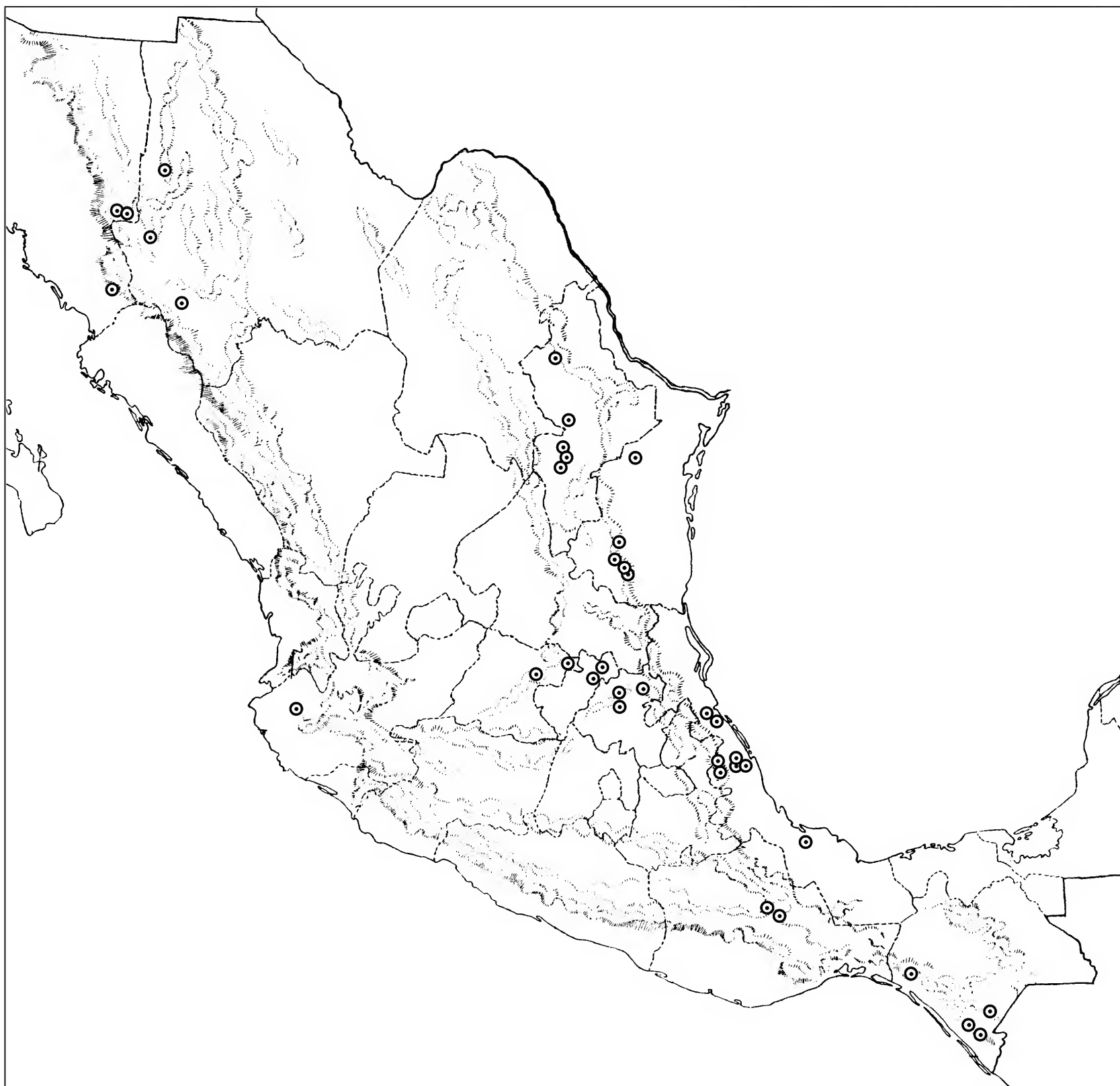


Map 2. Distribution of *Cartrema americana* in the USA. Records are from literature, internet, and first-hand herbarium sources. Arrow points to Virginia Beach County, the northernmost known site for the species.

In Mexico, *Cartrema americana* occurs in two widely disjunct north-south bands, following eastern and western sierras (Map 3). Numerous collections have been made in Chihuahua and Sonora, apparently few from Durango and Jalisco (Table 1). The species is relatively more common in the eastern states, judging from the abundance of collections.

Plants described in 1958 as *Osmanthus americanus* var. *microphyllus*, the type from a gypseous area in south-central Nuevo León, Mexico, can be seen with more collections now available as continuously variable with the rest of the species, agreeing with the earlier assessment by Rzedowski and Rzedowski (2004). In the description of *O. mexicanus* from Chiapas, Lundell (1938, p. 308) noted that it differed from previously described American species "by its small narrow caudate-acuminate leaves, blackened when dry, costa impressed above, and large stigma." Green





Map 3. Distribution of *Cartrema americana* in Mexico. Collections from Durango and San Luis Potosí, alluded to by Rzedowski & Rzedowski (2004) but not mapped here, allow distributions in both eastern and western sierras to be seen as essentially continuous, though apparently sporadic. Most symbols represent more than one collection. Records are from ARIZ and NMC (via SEINET), XAL (via REMIB), TEX-LL (from the Austin herbarium), and Rzedowski & Rzedowski (2004).

treated *O. mexicanus* as distinct in 1958, but at least by 1989 Green had changed his mind and annotated the type specimens at F and NY as *O. americanus*. The current study agrees that the Chiapas plants appear to be continuous with the rest of the species as it occurs northward.

Habitats of Mexican *Cartrema americana* are consistently different (higher elevation, drier sites, in temperate vegetation) from those in the southeastern USA, but no evident differences in morphology exist among Mexican population systems and the species in Mexico is similar to plants of the United States in morphology and range of variability. Fruit size essentially matches that of *C. americana* in the USA; mature fruits on herbarium specimens from Chiapas, Guanajuato, Nuevo León, Querétaro, Sonora, and Tamaulipas measured 7–11 mm. The larger sizes of (10–)12–16 mm

indicated by Rzedowski and Rzedowski (2004) perhaps were from measurements of fresh (vs. dried) fruits.

Rzedowski and Rzedowski (2004) noted that the leaves are produced in a diversity of shape and size — elliptic or lanceolate to oblanceolate, ovate, or obovate, 1.5–15 x 1–5 cm. They observed that one collection from Guanajuato identified as *Osmanthus americanus* might be a different species (presumably undescribed), because of its consistently small ovate to obovate leaves with rounded to emarginate apices: **Guanajuato**. Mpio. Xichú: Cerro Gordo, 12 km N de Molinitos, *Ventura y López 6736* (IEB, MEXU).

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TABLE 1. Collections of *Cartrema americana* from western Mexico; those from ARIZ and NMC from SEINET, not seen.

**Chihuahua.** Mpio. Batopilas: 3 mi S of Loreto, Rio Mayo Region, along small stream, 5300 ft, 24 May 1986, *Martin, Salmon, & Sundt s.n.* (ARIZ). Mpio. Temósachi: Nabogame, riverbank, 1800 m, 6 Dec 1987, *Laferrière 1320* (ARIZ, TEX). Mpio. Ocampo: Cascada de Basaseachic, base of falls, ashy volcanic rocks, 17 Mar 1986, *Donoghue s.n.* (ARIZ); Basaseachic, S overview to Rancho San Lorenzo Hotel, Rio Mayo Region, sterile tuff and meadow, 1 Oct 1986, *Martin s.n.* (ARIZ); Parque Nacional Cascada de Basaseachic, at overlook called the "Divisadero" ca. 1 km airline S of Cascada, in pine-oak woods, steep N bank, 2100 m, shrub 1.5–2 m tall, 3 Oct 1986, *Spellenberg, Soreng, Corral-Díaz, & Lebgue 8700* (NMC); Parque Nacional "Cascada de Basaseachic," along the trail from Divisadero I to Divisadero II, W slope, open, with pines, 2100 m, shrub ca. 1 m tall, 12 Nov 1989, *Spellenberg, Corral-Díaz, Lebgue, & Mahrt 10087* (BRIT, NMC). **Jalisco.** Mpio. Talpa de Allende: 6 km sobre la brecha a Talpa de Allende, entrando por la carr. Puerto Vallarta-El Tuito, bosque de pino-encino, 7 Mar 1992, *Campes V. 4526* (TEX 2 sheets). **Sonora.** Mpio. Alamos: ca. Arroyo Verde, Upper Rio Cuchujaqui, base of a rhyolite cliff, 16 May 1990, *Rondeau 90-32* (ARIZ). Mpio. Yécora: 21 km E of Yécora, Arroyo Los Pilares, upstream N of México 16, stream canyon forest, on slopes, 12 Mar 1996, *Reina G. 96-74* (ARIZ); 12.4 km NW of Yécora on road to La Trinidad, Arroyo Agua Blanca, Mesa Grande, pine-oak forest, 1700 m, common 1.5–2.5 m shrub, often with look-alike *Garrya laurifolia*, 29 Sep 1998, *Van Devender 98-1903* (NMC, TEX).

TABLE 2. Unequivocal identifications of *Cartrema floridana* (based on mature or maturing fruits).

**Florida.** Brevard Co.: *Curtiss* 5778 (USF). Citrus Co.: *Cooley* 6479 (USF); *Mawhinney* 22 (USF); *Mawhinney* 77 (USF). DeSoto Co.: E side of Cunningham Rd. ca. 2.6 mi N of State Rd. 70 and 0.5 mi E of Horse Creek, 24 Jul 1970, *Shuey* 2064 (FLAS). Hernando Co.: *Davis* s.n. (FLAS); *Genelle & Fleming* 422 (USF); *Godfrey* 57248 (USF); *vanHoek* WW0012 (USF). Highlands Co.: *Alcorn* 201 (FLAS); *Bishop & Harris* LJ0120 (USF); *Godfrey & Reinert* 61016 (BRIT, FLAS); *Judd* 5561 (FLAS, FTG); *Kral* 22891 (VDB); *Kral* 66203 (VDB); *McFarlin* 1114 (USF), 11115 (USF); *Orzell & Bridges* 15813 (FLAS, FTG, USF); *Skean* 2151 (FLAS); *vanHoek & Wargo* 782 (USF). Hillsborough Co.: *Bowman* s.n. (USF); *Eilers* s.n. (USF). Indian River Co.: *Kessler* s.n. (USF). Lake Co.: *Ward & Will* 3050 (FLAS, FSU, USF). Manatee Co.: *Becker* WCO456 (USF); *Gandy* LMO185 (USF). Marion Co.: *Thorne* 57971 (USF). Orange Co.: *Christman* 1883 (FLAS), *Christman* 2139 (FLAS), *Christman* 2140 (FLAS); *Wunderlin* 5645 (USF); *Wunderlin* 5327 (USF); *Wunderlin* 5702 (USF). Osceola Co.: *Baltzell* s.n. (FLAS); *Christman* 655 (FLAS), *Christman* 656 (USF); *Grey* s.n. (USF); *Huck* 4171 (FLAS, USF); *Kral* 64638 (TEX, VDB); *Schallert* 20855 (SMU). Pasco Co.: *vanHoek & Petty* WB252 (USF). Pinellas Co.: *Petty* s.n. (USF); *Ray et al.* 10932 (SMU, USF); *Ray et al.* 10964 (SMU, USF); *Thorne* 48334 (USF). Polk Co.: *Christman* 57 (FLAS), *Christman* 1039 (FLAS), *Christman* 2017 (USF), *Christman* 2084 (FLAS), *Conard* s.n. (FLAS); *Corogm* TC192 (FLAS); *DeLaney* 1786 (USF); *Lakela* 24568 (FLAS, USF); *Orzell & Bridges* 16621 (FTG); *Small* s.n. (USF). Sarasota Co.: *Franck* 889 (USF); *Kruea* s.n. (FLAS); *Rowe* 7290 (USF). Seminole Co.: *Ray* 10718 (USF). Sumter Co.: *Kral* 7848 (FLAS, USF). Volusia Co.: *Kunzer* 439 (USF).



# NOTES ON THE *GARRYA OVATA* COMPLEX (GARRYACEAE)

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## ABSTRACT

Each of the four subspecies of *Garrya ovata* sensu Dahling 1958 is recognized here at specific rank: *Garrya ovata* Benth., *Garrya lindheimeri* Torrey, *Garrya goldmanii* Woot. & Standl., and *Garrya mexicana* (Dahling) Nesom, **comb. nov.** *Garrya lindheimeri* and *G. goldmanii* occur in the USA and Mexico; the other two are endemic to Mexico. A lectotype is designated for *Garrya lindheimeri*.

**KEY WORDS:** *Garrya ovata*, Garryaceae, USA, Mexico

*Garrya ovata* Benth. was treated by Dahling (1958) as comprising four subspecies. All four taxa are treated here at specific rank, as *G. goldmanii*, *G. lindheimeri*, *G. mexicana*, and *G. ovata* in the strict sense. Morphological differences among these four *Garrya* species appear to be primarily in leaf morphology and vestiture. Rationale for their treatment at specific rank emphasizes aspects of geography, particularly these: (a) *G. mexicana* is geographically separate from the other three varieties; (b) *G. lindheimeri* and *G. goldmanii* have non-overlapping ranges, habitats, and morphologies in Texas; intergradation occurs where they are sympatric in Coahuila, but even where they co-occur they remain distinct for the most part; (c) typical *G. ovata* is sympatric with *G. lindheimeri* within southern Nuevo León, but they apparently do not intergrade.

The phylogenetic analysis of ITS data by Burge (2011) found that *Garrya lindheimeri* and *G. mexicana* show a sister relationship, but *G. ovata* and *G. goldmanii* were not included in the study. The *G. ovata* complex is part of *Garrya* subg. *Fadyenia* — of the other two *Garrya* species in northeastern Mexico and sympatric with the *G. ovata* complex, *G. glaberrima* Wang, is in subg. *Fadyenia*, *G. laurifolia* subsp. *macrophylla* (Benth.) Dahling in subg. *Garrya*. Neither species is known to hybridize with taxa of the *G. ovata* complex.

## KEY TO THE SPECIES

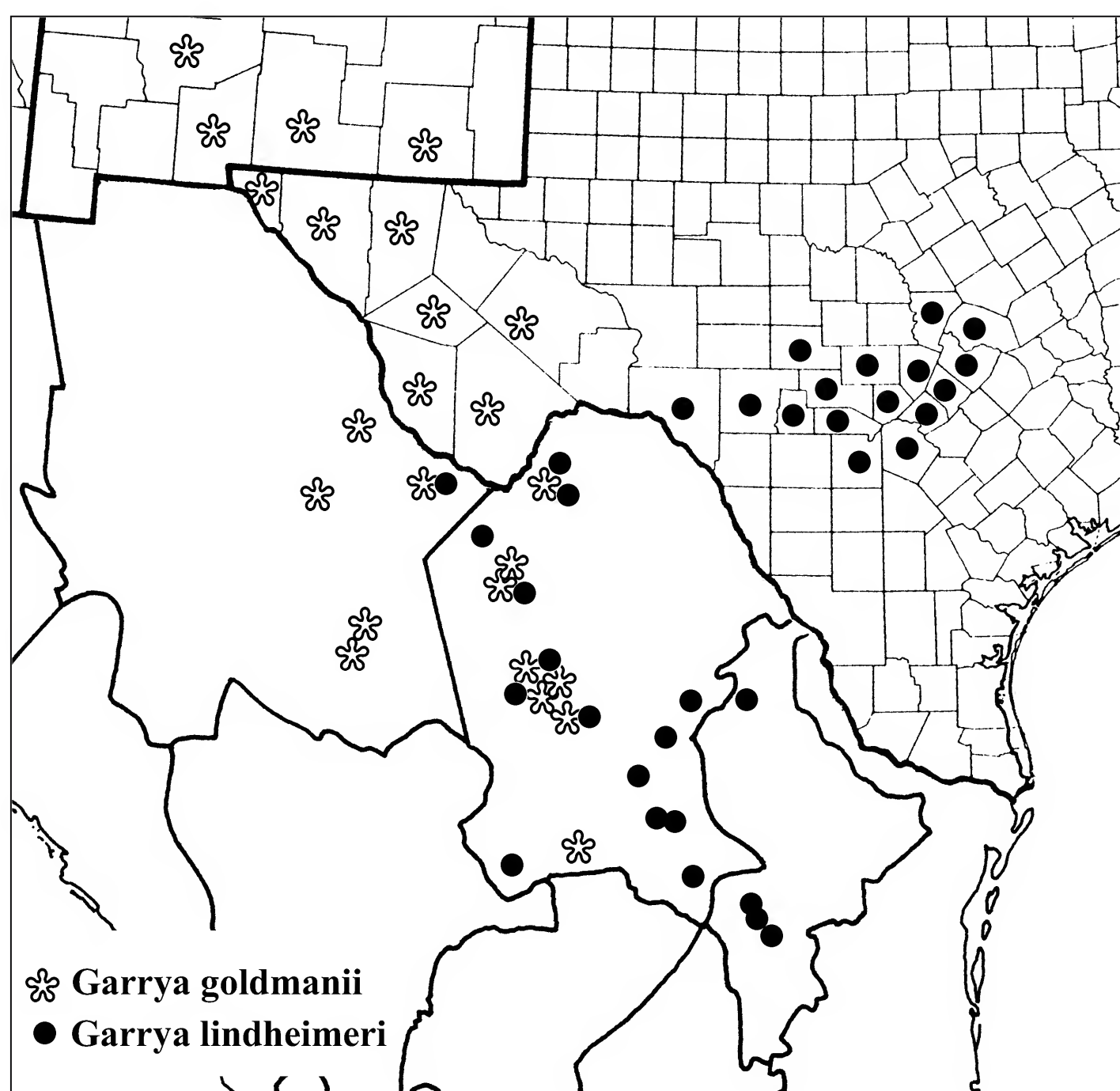
1. Leaf blades 16–40(–55) x 7–25 mm, densely and persistently tomentulose on both surfaces; petioles 3–8 mm long; leaf margins distinctly undulate, with a more or less muriculate-roughened callose rim especially above the middle ..... 1. *Garrya goldmanii*
1. Leaf blades 30–85(–95) x 15–55 mm, glabrous or glabrate to glabrescent adaxially, persistently hairy abaxially; petioles (5–)7–16(–20) mm long; leaf margins flat to slightly undulate, smooth (without a muriculate-roughened callose rim).
2. Vestiture of abaxial leaf surfaces usually densely (less commonly sparsely) sericeous to strigose or strigillose with wavy-straight hairs oriented in a single direction; adaxial surfaces highly glossy, with strongly reticulate-raised venation ..... 4. *Garrya ovata*
2. Vestiture of abaxial leaf surfaces either densely and persistently puberulent with coiling to recurved hairs -or- sparsely villous with short wavy-straight to curving hairs to glabrescent or glabrous, hairs irregularly oriented; adaxial surfaces glossy to dull, with slightly reticulate-raised venation.

3. Abaxial leaf surfaces densely and persistently puberulent with tightly coiling to strongly recurved hairs ..... 2. ***Garrya lindheimeri***  
 3. Abaxial leaf surfaces sparsely villous with short wavy-straight to curving hairs to glabrescent or glabrous ..... 3. ***Garrya mexicana***

**1. *Garrya goldmanii*** Woot. & Standl., Contr. U.S. Natl. Herb. 16: 157. 1913. *Garrya ovata* subsp. *goldmanii* (Woot. & Standl.) Dahling, Contr. Gray Herb. 209: 83. 1978. *Garrya ovata* var. *goldmanii* (Woot. & Standl.) B.L. Turner, Atlas Vasc. Pl. Texas, 7. 2003. **TYPE: USA. New Mexico.** Eddy Co.: limestone ledges near Queen, ca. 1770 m, 31 Jul 1909, *E.O. Wooton s.n.* (holotype: US digital image!; isotype: US digital image!).

In the protologue, Wooton and Standley made this observation: "This is undoubtedly closely related to [*Garrya ovata*] of central Mexico, but it differs in its lower growth, and small, narrow, more pubescent, crispate leaves. The leaves are much less conspicuously veined than in *G. ovata* and the fruit is much smaller."

A collection from Veracruz, Mexico, in the arid, karstic hills of Cofre de Perote, has been identified as *Garrya ovata* subsp. *goldmanii* (G. Castillo-Campos et al. 1998), but this locality is far disjunct from the range of *G. goldmanii*, seemingly part of that of *G. ovata* as mapped here (see Map 3); the identity needs to be studied in a larger context.



Map 1. Distribution of *Garrya goldmanii* and *G. lindheimeri*, based primarily on collections at TEX-LL. Records for Dona Ana, Otero, and Sierra counties, New Mexico, are from NMC and UNM, via SEINET.

2. *Garrya lindheimeri* Torrey in War Department [U.S.], Pacif. Railr. Rep. 4(5): 136. 1857. *Garrya ovata* var. *lindheimeri* (Torrey) J.M. Coulter & W.H. Evans, Bot. Gaz. 15: 94. 1890. *Garrya ovata* subsp. *lindheimeri* (Torrey) Dahling, Contr. Gray Herb. 209: 81. 1978. **LECTOTYPE** (designated here): USA. Texas. In expedition from western Texas to El Paso, New Mexico, May 1849–Oct 1849, C. Wright 633 (NY digital image!; isoelectotypes: GH 4 specimens).

The label of the NY sheet is annotated, apparently in Torrey's hand, as *Garrya lindheimeri* Torr. The protologue also noted that he had seen a Lindheimer collection, 2 sheets of this are at GH (*Lindheimer* 122, May 1846) and presumably one also exists at NY.

In Texas, *Garrya lindheimeri* occurs on the Edwards Plateau and adjacent Lampasas Cut Plain and within the state is completely separated from the range of *G. goldmanii* (Map 1). Dahling identified and mapped it as subsp. *lindheimeri*, geographically distinct in Texas but then sympatric with subsp. *goldmanii* southward through Coahuila. Correll and Johnston (1970) treated *G. lindheimeri* at specific rank, describing it as endemic to the Edwards Plateau and contrasting it in Texas with subsp. *goldmanii*. Diggs et al. (1999) treated it as *G. ovata* subsp. *lindheimeri*, without comment except for noting that it is a Texas endemic restricted to the Edwards Plateau and Lampasas Cut Plain.

In the assessment here, *Garrya lindheimeri* and *G. goldmanii* are sympatric in parts of Coahuila, particularly in the Sierra de la Madera, Sierra de San Marcos, and Sierra del Pino. For the most part the two species retain their morphological integrity and many collections of both species in typical form have been made in these mountains, but intermediates suggest that hybridization and perhaps introgression have occurred. *Garrya goldmanii* occurs in more xeric habitats, as indicated by the differences in distribution and ecology in Texas, and the ecological distinction also apparently exists in Coahuila. Their distinction where sympatric implies a degree of reproductive isolation and provides rationale for maintaining them both at specific rank.

The range of *Garrya lindheimeri* continues from Coahuila into south-central Nuevo León. The identity of a collection from northern Nuevo León cited and mapped by Dahling as subsp. *lindheimeri* is confirmed here as *G. lindheimeri*: Lampazos [de Naranjo], Salvador Resendez, 26 Jun 1937, *Edwards 360* (TEX!). This collection apparently was made at the north end of the Sierra Mamulique. Collections from the Sierra Gomas region slightly to the south of Lampazos all are *G. mexicana* (Map 1).

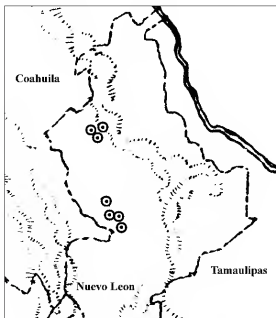
A collection from Sierra Rica in east-central Chihuahua, close to the Texas border, is mapped here as *Garrya lindheimeri* but the vestiture is atypical — abaxial leaf hairs are not tightly coiling but instead loosely wavy and longer. The leaves are relatively large and smooth-margined, thus it is not a variant of *G. goldmanii*, which occurs in typical form in the Sierra Rica. **Chihuahua**. Canyon in N face of Sierra Rica, S of Rancho La Consolación, *Quercus*, *Ptelea*, *Garrya*, *Juglans*, *Sageretia*, 3 May 1973, Johnston et al. 10771 (TEX).

3. *Garrya mexicana* (Dahling) Nesom, comb. nov. *Garrya ovata* subsp. *mexicana* Dahling, Contr. Gray Herb. 209: 84. 1978. **TYPE**: MEXICO. Nuevo León. Small trees on rocky mountain slope above Horse Tail Waterfalls, well above the road which is above Horse Tail Falls, El Cercado, 11 Feb 1972, G.V. Dahling 1180 (holotype: GH; isotype: TEX! digital image!).

*Garrya mexicana* is endemic to montane areas of north-central Nuevo León, where it is morphologically distinct and geographically disjunct from the other three taxa of the *G. ovata* complex. Its sparse abaxial leaf vestiture of relatively straight hairs contrasts sharply with that of *G. lindheimeri*, and leaves of *G. mexicana* are the largest of the species group (largest leaves on a plant are 5–8.5 cm x 2.5–5 cm).

Specimens examined from TEX-LL MEXICO Nuevo Leon Near tops of the mts surrounding Monterrey, about a 1/2 days climb, steep slopes, Feb 1972, *Dahling 118* (TEX), Mpio de Villa Santiago, Cañon Guajuco, Rancho Vista Hermosa, 24 Jun 1935, *Mueller 2031* (TEX), Mpio Bustamante, Sierra Gomas, Bustamante Canyon, N exposure, in a large arroyo on limestone derived soils, *Quercus-Vauquelinia-Ptelea* palm association, 1100 m, 13 Aug 1988, *Patterson 6626* (TEX), Mpio Villaladama, Sierra Gomas, in Canyon El Alamo, N exposed riparian community of *Quercus-Ostrya-Acer* on limestone-derived soil, 1100 m, 15 Aug 1988, *Patterson 6720* (TEX), Sierra Madre, near Monterrey, 17 Aug 1903, *Pringle 11816* (LL, TEX), Monterrey, at point farthest east on Chipinque road in thorn-oak ecotonal area, Feb 1961, *Smith 430* (TEX), Mpio Bustamante, Sierra Lampazos, Rancho Minas Viejas, bosque de *Quercus grisea*, *Tilia*, *Acer*, *Carpinus*, and *Myriopogon*, 1300-1400 m, 2 May 2001, *Villareal 9109* (TEX)

Dahling cited duplicates for some of these TEX-LL collections as well as other collections from the vicinity of Monterrey

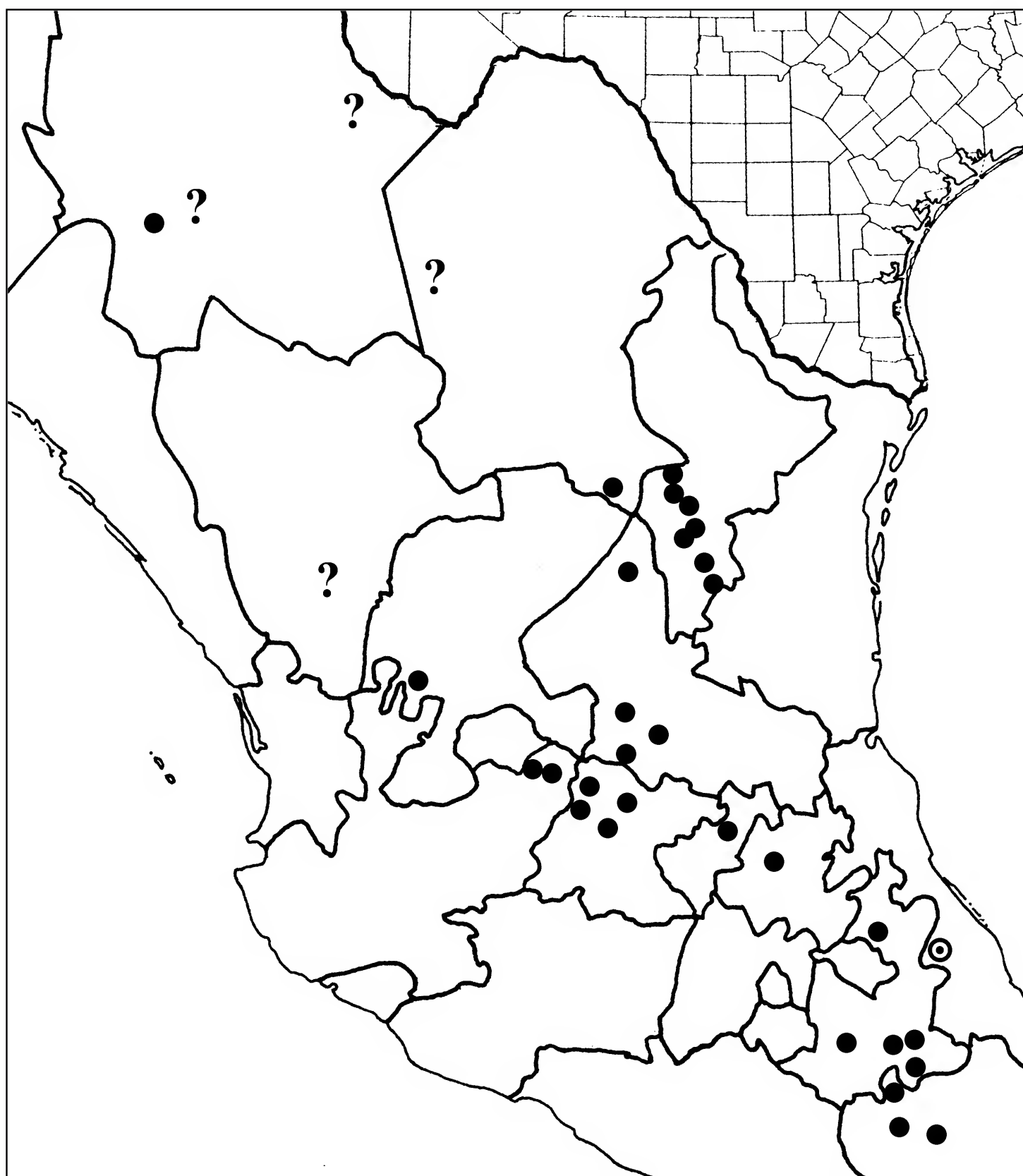


Map 2. Distribution of *Garrya noveboracensis* based on collections at TEX LL

4. *Garrya ovata* Benth., Pl. Hartw., 14. 1839. *Fadyenia ovata* (Benth.) Endl., Gen. Pl., Suppl. 4: 38. 1847[1848]. **TYPE: MEXICO. [Guanajuato]**. Gigante and on the Bufo Guanajuato [near the city of Guanajuato], 1839, *K.T. Hartweg* 80 (holotype: K; isotypes: BM digital image!, E digital image!, GH, LD digital image!, NY digital image!).

The BM sheet has these collection data: "In rapetibus sterilibus in Monte Gigante alt 9000 ped et in Monte Bufo prope Guanajuato." The protologue has no information about the locality.

Typical *Garrya ovata* is the most widespread and southern taxon of the group. It is known from Chihuahua, southern Coahuila, Guanajuato, Hidalgo, Jalisco, Puebla, Querétaro, San Luis Potosí, and Zacatecas (Dahling 1958; Carranza González 1996; specimens at TEX-LL; from Hidalgo, a collection from XAL fide REMIB). Two collections cited by Dahling from Chihuahua (not seen in present study) need to be reexamined. Durango is cited as part of the range of the species by Carranza González (1996), but I have not seen a voucher or voucher citation. A collection from Sierra Mojada in western Coahuila is cited by Dahling; a collection from Sierra Rica in northeastern Chihuahua might be interpreted as *G. ovata* (see citation above, under *G. lindheimeri*).



Map 3. Distribution of *Garrya ovata*, based primarily on collections seen at TEX-LL. Records from Guanajuato and Querétaro are added from Carranza (1996); the one from Hidalgo and two from Puebla are added from XAL (fide REMIB). The dotted circle in Veracruz is the locality of the collection identified as *G. ovata* subsp. *goldmanii* by Castillo-Campos et al. (1998). Presence in "?" regions is not unequivocally established (see text for comments).

Dahling cited two collections from central Nuevo León as typical *Garrya ovata*, but he did not map them or any others from that state as typical *G. ovata*. Nuevo León plants identified and mapped here as *G. ovata* may prove to represent two (or more) separate entities and to be distinct from the typical expression. Fruits in Nuevo León are glabrous, while in the southern segment (typical *G. ovata*) fruits consistently are hairy.

Plants from high elevation localities (ca. 2800 to 3700 meters) in Coahuila and Nuevo León (Sierra La Marta, Sierra La Viga, Sierra Coahuilón, Sierra Arteaga; Cerro Potosí, Cerro Peña Nevada) tend to have abaxial leaf surfaces densely sericeous with relatively long, wavy hairs and adaxial surfaces with strongly reticulate-raised venation. On gypsum outcrops at lower elevations, abaxial vestiture tends to be strigillose with shorter, straight hairs and adaxial surfaces have less strongly raised venation. Field study of population variation and habitat differentiation would be useful toward reaching a better understanding of the variation patterns.

#### ACKNOWLEDGEMENTS

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SYNOPSIS OF *LEUCOSYRIS*,  
INCLUDING SYNONYMOUS *ARIDA* (COMPOSITAE: ASTEREA)

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ABSTRACT

The genus *Leucosyris* is revived, reviewed, and expanded to include nine species from the southwestern USA and northern Mexico. *Arida* is reduced to synonymy of *Leucosyris*, and eight new combinations in *Leucosyris* are proposed.

**KEY WORDS:** *Arida*, Asteraceae, Astereae, Compositae, *Leucosyris*, *Machaeranthera*, *Psilactis*.

A generic review of the mostly radiate-capitulate *Machaeranthera* Nees alliance (Morgan and Hartman 2003) recognized the aptly named *Arida* (R.L. Hartm.) D.R. Morgan & R.L. Hartm. (Compositae: Astereae: Machaerantherinae), but did not emphasize that included within *Arida* was the type (*Liniosyris carnosa* A. Gray) of *Leucosyris* Greene (5 Aug 1897). Here, we emend that work by reducing *Arida* to taxonomic synonymy of a reinstated *Leucosyris*, a name which has priority over *Arida* by more than a century. We also provide a synopsis of *Leucosyris* and its nine species, abbreviated synonymy and typology, and eight new combinations in *Leucosyris*. As an aside, the illegitimate later homonym *Liniosyris* Cass. (1825; non *Liniosyris* Ludw., 1757, Santalaceae) is unavailable nomenclaturally and not congeneric taxonomically with our plants, but rather the Cassini name is typified by European material. It appears that the available name *Leucosyris* has often stood in the shadows, this perhaps a by-product of its type being described in *Liniosyris*.

*Machaeranthera* was described by Nees (1832) and accepted by Candolle (1836) and Gray (1852, 1853). Benth and Hooker (1873) reduced *Machaeranthera* to *Aster* sect. *Machaeranthera* (Nees) Benth. & Hook. f., in which Gray (1884) recognized seven species. *Machaeranthera* was reinstated as a genus by Greene (1896), and Greene (1899) recognized about two dozen species, these mostly taprooted and blue-rayed. Shinnars (1950) expanded *Machaeranthera* to include a few yellow-rayed species, but these yellow-rayed species were excluded from *Machaeranthera* by Cronquist and Keck (1957). Hartman (1976, 1990) reviewed *Machaeranthera* and recognized 36–38 species spread unequally among two subgenera and eight sections. Most of the species recognized by Hartman (1976, 1990) as *Machaeranthera* (i.e., *M.* subg. *Machaeranthera*) were characterized by having taproots, bristled- or pinnatifid leaves, ray florets with blue to less commonly white corollas, and base chromosome numbers of  $x = 4, 5$ , or 6, but the handful of species placed in *M.* subg. *Sideranthus* were yellow-rayed. Hartman (1976, 1990) recognized only two species of *M.* sect. *Machaeranthera*, and the larger sections he recognized included sect. *Blepharodon* (with nine species) and the newly described blue-rayed sect. *Arida* (with eight species).

At about the same time that Greene (1896, 1899) resurrected *Machaeranthera*, he (Greene 1897a) described *Leucosyris* to accommodate a single discoid species. *Leucosyris* (or its type, *Liniosyris carnosa*, albeit often as *Aster intricatus*) was subsequently recognized as including only



*Leucosyris* (*Chloracantha*) *spinosa* (Benth.) Greene by Wootton and Standley (1915), but treated within *Aster* by Hall (1907), Blake (1925, 1942), Jepson (1925), Tidestrom and Kittell (1941), Munz and Keck (1959), Ferris (1960), Shreve and Wiggins (1964), Munz (1974), Jones (1980), and Semple and Brouillet (1980). More recently, *Leucosyris* was recognized as monotypic by Sundberg (1986), with two species by Gandhi and Thomas (1989), *L. carnosa* was placed within *Machaeranthera* by Hartman (1976, 1990), Nesom (1989), Nesom et al. (1991), Keil et al. (1993), and Felger (2000), but *Leucosyris* was reinstated by Cronquist (1994), again as monotypic.

Morgan and Hartman (2003) summarized the recent dismantling of *Machaeranthera*, which they recognized in the narrow sense as containing only the two species of *M. sect. Machaeranthera* sensu Hartman (1976, 1990). Most former *Machaeranthera* species were treated by Morgan (1993) and Morgan and Hartman (2003) variously among resurrected *Dieteria* Nutt. ( $x = 4$ ; 3 spp.), *Psilactis* A. Gray ( $x = 3, 4, 9$ ; 6 spp.), *Xanthisma* DC. ( $x = 2, 3, 4, 8$ ; 17 spp., including yellow-rayed subg. *Sideranthus* as well as sect. *Blepharodon*), and the newly elevated *Arida*. Nesom and Robinson (2007) placed most of these genera into subtribe Machaerantherinae, but by non-bristle tipped leaf teeth and chromosome number they treated *Psilactis* as Symphyotrichinae. We recognize *Leucosyris* ( $x = 5$ ; 9 spp.) in the same sense that Morgan and Hartman (2003), Hartman and Bogler (2006), and Nesom and Robinson (2007) circumscribed *Arida*, despite the discrepancies between cpDNA and nrDNA studies (nrDNA studies place *L. parviflora* and *L. riparia* in different subclades), which Morgan and Hartman (2003) attributed to reticulate evolution.

**LEUCOSYRIS** Greene, Fl. Francisc. 384. (5 Aug) 1897. TYPE: *Limnocyris carnosa* A. Gray (= *Leucosyris carnosa* (A. Gray) Greene).  
*Machaeranthera* sect. *Arida* R.L. Hartm., Phytologia 68: 446. 1990. *Arida* (R.L. Hartm.) D.R. Morgan & R.L. Hartm., Sida 20: 1410. 2003. TYPE: *Machaeranthera arida* B.L. Turner & D.B. Horne (= *Leucosyris arida* (B.L. Turner & D.B. Horne) Pruski & R.L. Hartm.).

**Annual or biennial herbs to short-lived perennial weak subshrubs** 10–80(–150) cm tall, usually taprooted, infrequently rhizomatous; stems usually ascending to erect; herbage (when glandular) usually with short stipitate-glands. Leaves alternate, the basal (often withered) often petiolate, the cauline sessile and commonly clasping, entire to bipinnatifid, lobes or teeth often hyaline bristle-tipped, never sharply bristle-tipped, surfaces glabrous or pubescent, sometimes stipitate-glandular. **Capitulescence** corymbiform to open-cymose, capitula monocephalous on branchlets; peduncles often with bracteoles loosely grading into phyllaries. **Capitula** radiate (heterochromous) or infrequently discoid; involucre turbinate to hemispherical; phyllaries mostly 40+, imbricate, graduated, 3–8-seriate, persistent, linear-lanceolate to narrowly oblong, stiff, base usually indurate and stramineous, apex often with dark green to purplish mid-zone or more commonly patch, abaxial surface glabrous to pubescent or glandular; receptacle epalate, convex, somewhat alveolate. **Ray florets** (0 or) 8–50+, pistillate, 1-seriate; corolla limb usually pale blue to dark blue (infrequently white), usually drying brownish-yellow, often coiling when old or pressed. **Disk florets** (5)–10–100+, bisexual; corolla gradually narrow-funnelform, 5-lobed, yellow, lobes triangular; anthers pale, appendage lanceolate; style branch appendage narrowly triangular, papillose. **Cypselae** weakly dimorphic, those of the rays subtriquetrous, those of the rays disks subcompressed, narrowly oblong, stramineous to pale brownish, faces 7–13-striatulate, sericeous, distal trichomes of disk cypselae often reaching to pappus bristle base; pappus of many stramineous filiform capillary scabrid bristles, bristles contiguous basally, indistinctly ca. 2-seriate, disks always pappose, rays pappose or epappose.  $x = 5$ .

*Leucosyris* as treated here in the expanded sense basically may be thought of as a segregate of *Machaeranthera*. Indeed, revisionary treatments of three of its species by Turner and Horne (1964) as sect. *Psilactis* and of a fourth (*L. blepharophylla* as *M. gypsitherna*) by Nesom et al. (1990) as



sect. *Arida* were each under the umbrella of *Machaeranthera*. The base chromosome number of *Leucosyris* is  $x = 5$  and its species mostly have been reported under names in *Machaeranthera* (e.g., Arnold and Jackson 1978 and Turner et al. 1975). However, *Machaeranthera* in the strict sense differs from *Leucosyris* by a base chromosome number of  $x = 4$  and by sharply bristle-tipped leaf lobes. Genera in which the basionyms of our nine recognized species were described include *Arida* (1 sp.), *Aster* (2 spp.), *Linosyris* (1 sp.), *Machaeranthera* (3 spp.), and *Psilactis* (2 spp.). Attempted lectotypifications of a few names based on sheets taken here as Asa Gray holotypes have been hazarded elsewhere, but none affect any species circumscriptions. The nine species of *Leucosyris* are mostly summer- or late-blooming and occur from sea-level to about 2200 meters elevation in salt flats, scrub lands, dunes, deserts, sulphur pools, limestone hills, cliff faces, or less commonly along streambanks or in flood plains of the southwestern USA and northern Mexico, with only *L. riparia* (Kunth) Pruski & R.L. Hartm occurring as far south as Durango and Zacatecas (and perhaps Guanajuato), Mexico, near the Tripic of Cancer.

**Etymology:** The name *Leucosyris* Greene is derived from *Linosyris* Cass., which is typified by *Chrysocoma linosyris* L. (now *Crimetaria linosyris* (L.) Less.). The Linnaean epithet alludes to the resemblance of the linear-leaved composite to the subsucculent-leaved European-African Santalaceae genus *Osyris* L. Indeed, the protologue of *C. linosyris* cited the pre-Linnaean 1601 Clusius usage of *Osyris austriaca* as an original element of the composite. Jackson (1987) and Hyam and Pankhurst (1995) noted that *Osyris* (used by Bauhin, Dioscorides, Pliny, van Royen, etc.) is derived from the Greek *ozos*, in reference to the dense branching of the Santalaceae genus. The name *Leucosyris*, derived from *ozos*, is thus not a homonym of *Leucoseris* Nutt., wherein the suffix *seris* (Brown 1956) is a Latin word for "a kind of endive."

#### KEY TO SPECIES OF LEUCOSYRIS

1. Capitula discoid (sparsely leafy to nearly leafless wiry-reedy or rounded and tumbleweed-like subshrubby herbs) ..... *Leucosyris carnosa*
1. Capitula radiate.
  2. Ray cypselae pappose.
    3. Cauline leaves entire, subsucculent.
      4. Caespitose perennials; leaf margins 8–20-spinulose-ciliate, spinules 0.4–1.5 mm long; involucre 5–8 mm diam. .... *Leucosyris blepharophylla*
      4. Annual leaf-stemmed herbs; leaf margins sometimes soft-ciliate; involucre 10–16 mm diam. .... *Leucosyris riparia*
    3. Cauline leaves (mostly) pinnatifid to 2-pinnatifid, chartaceous.
      5. Receptacles 2–7 mm diam.; phyllary apices mostly appressed ..... *Leucosyris parviflora* (in part)
      5. Receptacles 8–11 mm diam.; phyllary apices spreading to reflexed ..... *Leucosyris turneri*
  2. Ray cypselae usually epappose.
    6. Basal rosette persistent ..... *Leucosyris mattturneri*
    6. Basal leaves usually absent at anthesis.

7. Herbage densely stipitate-glandular (at least some cauline leaves pinnatilobed).
8. Herbage heterotrichous; involucre 3.5–6 × 5–9 mm; disk pappus bristles ca. 2 mm long, about half as long as disk corollas ..... *Leucosyris arida*
8. Herbage homotrichous; involucre 6–8 × 10–15 mm; disk pappus bristles 3–3.5 mm long, more than half as long as disk corollas ..... *Leucosyris crispa*
7. Herbage essentially glabrous to sparsely glandular.
9. Cauline leaves entire to shallow-toothed ..... *Leucosyris coulteri*
9. Cauline leaves usually pinnatilobed to 2-pinnatifid ..... *Leucosyris parviflora* (in part)

**LEUCOSYRIS ARIDA** (B.L. Turner & D.B. Horne) Pruski & R.L. Hartm., comb. nov. *Machaeranthera arida* B.L. Turner & D.B. Horne, Brittonia 16: 324. 1964. *Machaeranthera coulteri* var. *arida* (B.L. Turner & D.B. Horne) B.L. Turner, Phytologia 61: 144. 1986. **TYPE:** USA. California. San Bernardino Co.: Mesquite Valley, 15 May 1941, *Wolf 10635* (holotype: DS; isotypes: CAS, NY, RSA, TEX-2, UC). Figure 1.

*Arida arizonica* (R.C. Jacks. & R.R. Johnson) D.R. Morgan & R.L. Hartm.; *Machaeranthera ammophila* Reveal; *Machaeranthera arizonica* R.C. Jacks. & R.R. Johnson

**Annual low-rounded** taprooted herbs 5–30(–40) cm tall; stems 1(–6), moderately branched and leafy throughout, branches spreading-ascending; herbage densely short-stipitate-glandular, sometimes heterotrichous and also sparsely pilose-villous. **Leaves:** basal usually absent at anthesis; cauline 1–5 cm long, oblong in outline, margins entire to more commonly at least some pinnatilobed, apical mucro of lobes and teeth (usually 2–5 per side) about as long as or slightly longer than the stipitate-glands. **Capitula** radiate; involucre 3.5–6 × 5–9 mm, hemispherical; phyllaries 2–4-seriate. **Ray florets** 20–40; corolla limb 5–8 mm long. **Disk florets** 28–60; corolla 4–6 mm long. **Cypselae** 1.4–2 mm long, rays epappose, disk pappus bristles ca. 2 mm long, about half as long as disk corollas.  $2n = 10$ .

**Distribution.** USA (Arizona, California, Nevada) and Mexico (Sonora); 0–1000 meters elevation.

Turner and Horne (1964) and Munz (1974) noted that the name *Psilactis coulteri* was often misapplied to *Leucosyris arida* (e.g., Hall 1907; Munz and Keck 1959; Ferris 1960). The name *Arida arizonica*, based on the senior synonym, was used by Morgan and Hartman (2003) for this taxon. Line drawings of *Leucosyris arida* were provided by Ferris (1960, as *Psilactis coulteri*), Keil et al. (1993, as *M. arida*), Felger (2000, as *M. coulteri* var. *arida*), Hartman and Bogler (2006, as *Arida arizonica*), and Keil et al. (2012, as *A. arizonica*).

**LEUCOSYRIS BLEPHAROPHYLLA** (A. Gray) Pruski & R.L. Hartm., comb. nov. *Aster blepharophyllus* A. Gray, Smithsonian Contr. Knowl. [Plantae Wrightianae II] 5(6): 77. 1853. *Machaeranthera gypsitherma* Nesom, Vorobik & Hartman, Syst. Bot. 15: 638. 1990 (non *M. blepharophylla* (A. Gray) Shinnars, basionym in *Haplopappus*). *Arida blepharophylla* (A. Gray) D.R. Morgan & R.L. Hartm., Sida 20: 1413. 2003. **TYPE:** USA. New Mexico. Hidalgo Co.: Las Playas Springs, 7 Oct 1851, *Wright 1164* (holotype: GH; isotypes, CGE, GH, MO, NY, P, PH, US). Figure 2.

**Caespitose perennial** rhizomatous herbs 4–35 cm tall; stems 4–12+ from woody crown, sparingly branched in distal half, branchlets somewhat fastigiate, erect-ascending; herbage glabrous or nearly so. **Leaves** dimorphic, basal and cauline; basal present at anthesis, in compact persistent rosette, sessile, 1–4 cm long, linear-spatulate, subsucculent, base clasping, margins entire, 8–20-spinulose-ciliate, spinules 0.4–1.5 mm long, subequal, sometimes as long as blade width; cauline abruptly reduced and scale-like. **Capitula** radiate; involucre 7–10 × 5–8 mm, turbinate; phyllaries 4–6-seriate; receptacle often noticeable alveolate with lacerate borders to 0.5 mm tall. **Ray florets** 8–14; corolla limb 8–10 mm long. **Disk florets** 12–20+; corolla 4.5–5.5 mm long. **Cypselae** 1.7–2.4 mm long, rays pappose.  $2n = 10$ .



Figure 1. Representative specimen of *Leucosyris arida* (B.L. Turner & D.B. Horne) Pruski & R.L. Hartm. (Parish & Parish 1252, MO; this collection was cited by Hall 1907 as *Psilactis coulteri*).



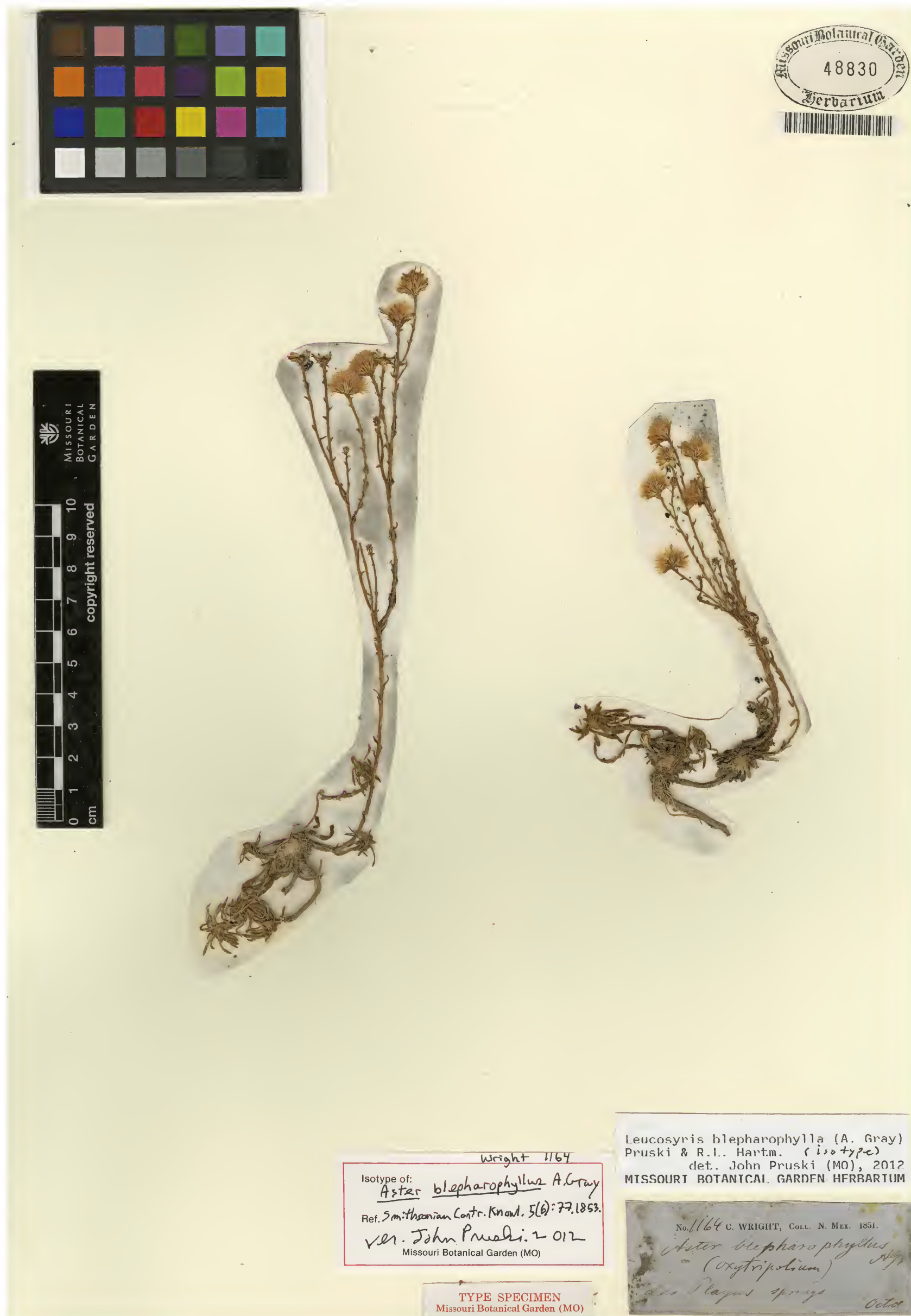


Figure 2. Isotype of *Aster blepharophyllus* A. Gray ( $\equiv$  *Leucosyris blepharophylla* (A. Gray) Pruski & R.L. Hartm.). (Wright 1164, MO).

**Distribution.** USA (New Mexico, Texas) and Mexico (Chihuahua); 1200–2200 meters elevation.

*Leucosyris blepharophylla* was described by Gray (1853) in *Aster* sect. *Oxytripolium* (DC.) Torr. & A. Gray. The orthography of the epithet is retained as it may refer to the dense cloaking leaf rosettes or to leaves resembling sect. *Blepharodon*, although as likely it may refer to the leaves with marginal leaf spinules similar to those of African *Blepharis* Juss. (Acanthaceae). Nesom et al. (1990) provided a line drawing under the name of *Machaeranthera gypsitherma*.

**LEUCOSYRIS CARNOSA** (A. Gray) Greene, Fl. Francisc. 384. (5 Aug) 1897. *Linosyris carnosa* A. Gray, Smithsonian Contr. Knowl. [Plantae Wrightianae II] 5(6): 80. 1853. *Bigelowia carnosa* (A. Gray) Benth. & Hook. f., Gen. Pl. 2: 255. 1873. *Aster carnosus* (A. Gray) A. Gray ex Hemsl., Biol. Cent.-Amer., Bot. 2: 120. 1881 (non Gilib. 1781). *Machaeranthera carnosa* (A. Gray) G.L. Nesom, Phytologia 67: 439. 1989. *Arida carnosa* (A. Gray) D.R. Morgan & R.L. Hartm., Sida 20: 1413. 2003. **TYPE:** USA. Arizona. Cochise Co.: south of Willcox Playa [fide Sundberg 1986; protologue locality as "west of the Chiricahua Mts., Sonora" and collection number originally 489], 6 Sep 1851, *Wright 1187* (holotype: GH; isotypes: GH, MO, PH, US-2). Figure 3.

*Aster intricatus* (A. Gray) S.F. Blake; *Bigelowia intricata* A. Gray; *Leucosyris carnosa* var. *intricata* (A. Gray) Cronquist; *Machaeranthera carnosa* var. *intricata* (A. Gray) Nesom

**Sparsely leafy to nearly leafless wiry-reedy or rounded and tumbleweed-like perennial rhizomatous subshrubby herbs** 0.3–1(–1.4) m tall; stems 1–several, moderately to intricately divaricate-branched throughout or only so somewhat above base, stiff, inconspicuously leafy distally, distal branches sometimes nearly fastigiate, ascending with branches and branchlets spreading, pale green; herbage glabrous and leaves glaucous. **Leaves:** basal absent at anthesis; cauline mostly distal, often quickly deciduous, spreading to nearly appressed, inconspicuous, well-spaced and scale-like, 0.3–2 cm long, narrowly lanceolate or narrowly oblanceolate, subsucculent, margins entire, apex apiculate. **Capitula** discoid; involucre 5–8 × 4–7 mm, turbinate to turbinate-campanulate; phyllaries strongly graduated, 4–6-seriate, dark mid-zone often narrow, some subcuspidate. **Ray florets** absent. **Disk florets** (5–)10–30(–40); corolla 5–7 mm long. **Cypselae** 2.5–4 mm long, pappose.  $2n = 10$ .

**Distribution.** USA (California, Arizona, Nevada) and Mexico (Sonora), often growing in otherwise basically barren ground; 100–1600 meters elevation.

Gray (1852, 1853) treated eight species in *Linosyris* (20+ American species have at one time or another been placed in *Linosyris*), described ours as "*L. ? carnosa*," and mentioned that it looked like "a *Tripolium* without rays." *Leucosyris carnosa* (the genotype), especially the nearly leafless *Bigelowia intricata* phase, brings to mind leafless *Chloracantha spinosa*, also placed by Greene (1897b) into *Leucosyris*. However, the more widespread *Chloracantha* Nesom et al. ranges from Louisiana to California and south from Mexico and Guatemala to Costa Rica and western Panama, and differs from *Leucosyris* by a base chromosome number of  $x = 9$ , thorny stems, short-radiate capitula, and glabrous cypselae. Line drawings of *Leucosyris carnosa* were provided by Ferris (1960, as *Aster intricatus*), Sundberg (1986, as *L. carnosa*), Cronquist (1994, as *L. carnosa* var. *intricata*), and Keil et al. (2012, as *Arida carnosa*).





Figure 3. Isotype of *Linostyris carnosa* A. Gray ( $\equiv$  *Leucosyris carnosa* (A. Gray) Greene). (Wright 1187, MO).





Figure 4. Representative specimen of *Leucosyris crispa* (Brandeggee) Pruski & R.L. Hartm. (Hartman et al. 3524, MO).

**LEUCOSYRIS COULTERI** (A. Gray) Pruski & R.L. Hartm., comb. nov. *Psilactis coulteri* A. Gray, Mem. Amer. Acad. Arts, n.s. [Plantae Fendlerianae] 4(1): 72. 1849. *Machaeranthera coulteri* (A. Gray) B.L. Turner & D.B. Horne, Brittonia 16: 322. 1964. *Arida coulteri* (A. Gray) D.R. Morgan & R.L. Hartm., Sida 20: 1414. 2003. TYPE: MEXICO. Sonora. Probably near the coast by Guaymas, s.d., *Coulter 295* (holotype: GH p.p., right-hand side; mounted on the same sheet towards the left is *Gregg 409*, which belongs to a different taxon).

**Wiry-reedy perennial** taprooted herbs 15–45 cm tall; stems few-branched, weakly ascending to procumbent, nearly leafy throughout or only distally so; herbage sparsely to moderately sessile-glandular (homotrichous) or stems nearly glabrous. Leaves: basal usually absent at anthesis; cauline 0.5–3 cm long, linear-lanceolate, margins entire to shallow-toothed. Capitula radiate; involucre 8–10(–11) × 5–8 mm, hemispherical; phyllaries ca. 40, 3–5-seriate. Ray florets ca. 33; corolla limb 5–8 mm long. Disk florets 40–60; corolla 3.5–4 mm long. Cypselae 1–1.5 mm long, rays (usually) epappose.  $2n = 10$ .

**Distribution.** Mexico (Sonora); 0–100 meters elevation.

*Leucosyris coulteri* was one of the two original species, but not the type, of *Psilactis* A. Gray (1849).

**LEUCOSYRIS CRISPA** (Brandege) Pruski & R.L. Hartm., comb. nov. *Psilactis crisper* Brandege, Proc. Calif. Acad. Sci., ser. 2, 2: 169. 1889. *Machaeranthera crisper* (Brandege) B.L. Turner & D.B. Horne, Brittonia 16: 321. 1964. *Arida crisper* (Brandege) D.R. Morgan & R.L. Hartm., Sida 20: 1414. 2003. TYPE: MEXICO. Baja California Sur. San Ignacio, 1 Apr 1889, *Brandege s.n.* (holotype: UC; isotypes: GH, PH, US). Fig. 4.

**Annual or short-lived perennial** herbs 20–50 cm tall, from thick taproot; stems 1–few from base, ascending to erect, fairly leafy and moderately branched throughout, mid-stems homotrichous with stipitate-glandular trichomes, branches ascending; herbage densely stipitate-glandular, homotrichous. Leaves: basal absent at anthesis; cauline 0.5–4 cm long, linear-oblong, few-pinnatifid about halfway to midrib, lobes (teeth) well-spaced. Capitula radiate; involucre 6–8 × 10–15 mm, hemispherical; phyllaries 3–5-seriate, apex sometimes spreading. Ray florets 30–40; corolla limb 6–8 mm long. Disk florets 40–60; corolla 3.8–6 mm long. Cypselae 2–2.4 mm long, rays usually epappose, disk pappus bristles 3–3.5 mm long, more than half as long as disk corollas.  $2n = 10$ .

**Distribution.** Mexico (Baja California Sur, Sonora; *Leucosyris crisper* was given as endemic to Baja California Sur by Shreve and Wiggins (1964) and Wiggins (1980), but Hartman (1976, 1990) and Felger (2000) gave it as also occurring in coastal Sonora; 50–170 meters elevation.

**LEUCOSYRIS MATTURNERI** (B.L. Turner & G.L. Nesom) Pruski & R.L. Hartm., comb. nov. *Arida matturneri* B.L. Turner & G.L. Nesom, Sida 20: 1418. 2003. TYPE: USA. Texas. Presidio Co.: ca. 2.2 miles NNW of Ruidosa, 20 Jul 2003, *Turner 100* (holotype: TEX; isotype: NY).

**Perennial subcaespitose** taprooted herbs 50–80 cm tall, from persistent basal rosette; stems several, much-branched, erect or ascending, sparsely leafy, stiff; herbage sessile-glandular or short-stipitate-glandular, viscid. Leaves basal and cauline, surfaces densely glandular, basal rosette leaves persistent, 4–6 cm long, bipinnatifid, oblanceolate to broadly obovate in outline, basal ones abruptly grading into cauline, these linear-oblanceolate. 1-pinnatifid to toothed or entire, ultimate ones scale-like. Capitula radiate; involucre 5–6 × 6–8 mm, hemispherical; phyllaries 5–6-seriate, oblong-



lanceolate, at least the outer with apices spreading. Ray florets 9–13; corolla 10–12 mm long, limb 9–10 mm long. Disk florets 40–100; corolla 3.5–4.5 mm long. Cypselae 1–1.5 mm long, rays epappose.  $2n = 10$ .

**Distribution.** USA (Texas) and expected in adjacent Mexico (Chihuahua, Coahuila); 1400–1500 meters elevation.

Turner and Nesom (2003) provided both habit and floral photographs of *Leucosyris matthurneri*.

**LEUCOSYRIS PARVIFLORA** (A. Gray) Pruski & R.L. Hartm., comb. nov. *Machaeranthera parviflora* A. Gray, Smithsonian Contr. Knowl. [Plantae Wrightianae I] 3(5): 90. 1852. *Aster parviflorus* (A. Gray) A. Gray, Bot. California 1: 322. 1876 (non *A. parviflorus* Nees 1832). *Aster parvulus* S.F. Blake, Contr. U.S. Natl. Herb. 25: 563. 1925 (non *A. parviflorus* Nees 1832). *Arida parviflora* (A. Gray) D.R. Morgan & R.L. Hartm., Sida 20: 1414. 2003. **TYPE:** USA. New Mexico. Along the Rio Grande, Sep 1849, *Wright 271* (holotype: GH; isotypes: BM, NY, P, US).

*Aster tanacetifolius* var. *pygmaeus* (A. Gray) A. Gray; *Machaeranthera pygmaea* (A. Gray) Woot. & Standl.; *Machaeranthera tanacetifolia* var. *pygmaea* A. Gray

**Annual, biennial, or short-lived perennial** taprooted herbs 10–30(–40) cm tall; stems 1–several from sometimes woody taproot, moderate-branched and leafy throughout, erect or ascending; herbage glabrous to sparsely stipitate-glandular and then somewhat viscid. Leaves: basal absent at anthesis; cauline 1–3 cm long, lanceolate to oblong, chartaceous, base often clasping, margins usually few-pinnatifid to 2-pinnatifid (sometimes distal stem leaves nearly entire to shallowly pinnatifid), the distal ones weakly spreading or more commonly ascending. Capitula radiate; involucre 3–5 × 4–6 mm, hemispherical; phyllaries 3–4-seriate, minutely glandular, apices mostly appressed; receptacle 2–7 mm diam. Ray florets 10–32; corolla limb 6–8 mm long. Disk florets 18–40+; corolla 3.5–4.5(–5) mm long. Cypselae 1.5–2 mm long, rays pappose or epappose.  $2n = 10$ .

**Distribution.** USA (Arizona, Colorado, New Mexico, Texas, Utah) and Mexico (Chihuahua, Coahuila); 1100–1700 meters elevation.

*Leucosyris parviflora* was illustrated by Martin and Hutchins (1988), Cronquist (1994), and Ivey (2003) as *Machaeranthera parviflora*.

**LEUCOSYRIS RIPARIA** (Kunth) Pruski & R.L. Hartm., comb. nov. *Aster riparius* Kunth, Nov. Gen. Sp. (folio ed.) 4: 72. 1820[1818]. *Machaeranthera riparia* (Kunth) A.G. Jones, Syst. Bot. 8: 85. 1983. *Arida riparia* (Kunth) D.R. Morgan & R.L. Hartm., Sida 20: 1414. 2003. **TYPE:** MEXICO. "Crescit in humidis juxta lacum Cuiseo" (given in Stearn 1968 as Cuitzeo and visited in Sep. 1803, see below), *Humboldt & Bonpland s.n. (4308)* (holotype: P-HBK; isotypes: B-W 15821, P). Figure 5.

*Aster sonora* A. Gray; *Machaeranthera sonora* (A. Gray) Sticky

**Wiry-reedy annual** taprooted herbs 25–60 cm tall; stems 1–several, moderately-branched distal in 2/3, erect to sometimes procumbent, leafy throughout, stiff, branches strongly ascending, sometimes striped (costae pale) longitudinally; herbage glabrous or nearly so. Leaves mostly cauline, strongly ascending to distal ones nearly appressed, sessile, 0.5–3 cm long, oblanceolate, lanceolate to oblong, subsucculent, broad-based, margins entire, sometimes soft-ciliate, apex mucronate. Capitula

radiate; involucre 10–12 × 10–16 mm, hemispherical; phyllaries 5–8-seriate, some attenuate. **Ray florets** 30–50+; corolla limb 8–11 mm long, sometimes white. **Disk florets** (25–)40–80+; corolla 3.5–5 mm long, lobes sometimes long-triangular. **Cypselae** 2–3 mm long, rays pappose.  $2n = 10$ .



Figure 5. Isotype of *Aster sonorae* A. Gray (= *Leucosyris riparia* (Kunth) Pruski & R.L. Hartm.). (Wright 1163, MO).



**Distribution.** USA (Arizona and New Mexico, where sometimes hybridizing, fide Stucky 1978 and Hartman 1990, with *L. parviflora*) and Mexico (Chihuahua, Coahuila, Durango, Zacatecas, ?Guanajuato); 900–2000 meters elevation.

The protologue locality of Cuitzeo (as "Cuiseo") as given by Stearn (1968) was visited by Humboldt and Bonpland in September 1803. Modern gazetteers list place names of Cuitzeo in Guanajuato, Jalisco, and Michoacan. The possible Humboldt and Bonpland type collection locality near Laguna de Cuitzeo seems to be between northern Michoacan and Guanajuato, somewhat south of Durango and Zacatecas, the southern-most distribution of the species known to us. The northwestern-most Mexican localities visited by Humboldt and Bonpland are near Guanajuato (Stearn 1968), and McVaugh (1984) did not list this species for *Novo-Galicia*. We cannot place with any degree of certainty the type collection locality of *Aster riparius*.

Stucky (1978) discussed seven hybrids in the *Machaeranthera* group and noted that the highest pollen fertility observed was in hybrids between *L. parviflora* (as *M. parviflora*) and *L. riparia* (as *Aster sonora*), prompting him to propose the combination *M. sonora*. As noted by Morgan and Hartman (2003), the Stucky (1978) results strengthen the generic limits based on cpDNA evidence. *Aster sonora* is usually treated in synonymy, but was resurrected by Turner et al. (1975), and reduced again by Jones (1983).

**LEUCOSYRIS TURNERI** (M.L. Arnold & R.C. Jacks.) Pruski & R.L. Hartm., comb. nov.  
*Machaeranthera turneri* M.L. Arnold & R.C. Jacks., Syst. Bot. 3: 209. 1978[1979]. *Arida turneri* (M.L. Arnold & R.C. Jacks.) D.R. Morgan & R.L. Hartm., Sida 20: 1414. 2003.  
**TYPE: MEXICO. Chihuahua.** 3.3. miles N of Meoqui, 1 Aug 1964, Jackson 4005 (holotype: TTC).

**Annual** taprooted herbs to 1.5 m tall; stems branched, proximal stems sometimes decumbent, leafy mostly in distal half; herbage stipitate-glandular. **Leaves:** basal usually absent at anthesis; cauline usually deeply pinnatilobed and lanceolate in outline, chartaceous. **Capitula** radiate; involucre 7–10 × 10–17 mm, hemispherical; phyllaries 64–134, linear-lanceolate, apices spreading to reflexed; receptacle 8–11 mm diam. **Ray** florets 40–60; corolla 11–15 mm long. **Disk** florets 80–150+; corolla 4.5–6 mm long. **Cypselae** ca. 2.5 mm long, rays papose.  $2n = 10$ .

**Distribution.** Mexico (Chihuahua, Coahuila); 1100–1300 meters elevation.

#### EXCLUDED SPECIES

*Leucosyris spinosa* (Benth.) Greene, Pittonia 3: 244. (9 Dec) 1897. Basionym: *Aster spinosus* Benth. ≡ *Chloracantha spinosa* (Benth.) G.L. Nesom, Phytologia 70: 378. 1991.

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## BARCODING THE ASTERACEAE OF TENNESSEE, TRIBES GNAPHALIEAE AND INULEAE

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### ABSTRACT

Results from barcoding studies of tribes Gnaphalieae and Inuleae for the Tennessee flora using data from the nuclear ribosomal ITS marker region are presented, and include first complete reports of this marker for 10 of the 13 species of these tribes that occur in the state. Sequence data from the ITS region separated all genera and most species of Gnaphalieae from Tennessee. Species pairs that were not distinguished included *Antennaria plantaginifolia*/ *A. parlinii* and *Pseudognaphalium helleri*/ *P. micradentum*. The ITS sequence data provided supporting evidence for recent changes in the classification of the group, most notably segregation of *Gamochaeta* and *Pseudognaphalium* from *Gnaphalium*, as well as the species-level taxonomy of *Gamochaeta*. Issues were noted with current GenBank records, including apparent poor quality of some sequence data and possible mistakes in species identifications, which must be taken into account in barcoding efforts and which highlight the need to expand this highly useful database.

**KEY WORDS:** Asteraceae, Gnaphalieae, Inuleae, molecular barcoding

The Gnaphalieae, generally referred to as “cudweeds”, are relatively anonymous yet common and widespread plants. They can be easily be overlooked or passed up by collectors. The major diversification of the tribe has occurred in the southern hemisphere, and the species from southeastern North America have not been well sampled in broad phylogenetic surveys of the tribe (e.g. Ward et al. 2009; Galbany-Casals et al. 2010; Nic et al. 2012). The current study was undertaken as part of a general effort to increase sampling for molecular markers of Asteraceae from southeastern North America in general and the state of Tennessee in particular.

The classification of Gnaphalieae has changed dramatically at several levels in recent years. Gnaphalieae were once included in Inuleae, but more recent studies have shown that the two tribes are clearly distinct (Bremer et al. 1994). Both tribes are characterized by having heads that are often discoid or disciform, but Gnaphalieae is the sister group to Astereae and Anthemidae whereas Inuleae is a lineage at the base of the clade that includes the Heliantheae alliance (Funk et al. 2009). The generic level classification has also changed, with a formerly large *Gnaphalium* retaining the Old World species but the basically New World *Gamochaeta* and *Pseudognaphalium* being segregated (Nesom 1990). Species level recognition has also been sharpened through careful studies that have refined circumscriptions and even described several previously unrecognized species in *Gamochaeta* and *Pseudognaphalium* (Nesom 1990, 2001a, 2004a). The relatively technical features required to recognize accurately species of the genera of Gnaphalieae make them a logical target that would benefit from a molecular barcoding approach (Kress et al. 2005) to verify identifications.

Gnaphalieae are represented in the state of Tennessee by a total of 12 species (Table 1), most of which were traditionally placed (e.g. Cronquist 1980) in two genera, *Gnaphalium* and *Antennaria*, as well as the introduced *Facelis*. Current classification separates *Gnaphalium* in Tennessee into

three different genera, including *Gamochaeta* and *Pseudognaphalium* (Table 1). Inuleae is represented by a single species, *Pluchea camphorata*.

Most of the species of Gnaphalieae in Tennessee are currently considered to be native to the flora, although their ruderal nature makes it difficult to be certain in all cases (Nesom 2004b). A species that appears to be clearly introduced is *Facelis retusa*, a South American weedy species (Cronquist 1980). *Gnaphalium uliginosum* is considered by Cronquist (1980) to be introduced from Europe, although its probable sister relationship to *G. exaltifolium* A. Nelson suggests that it is likely also to be native, perhaps in part, to North America (Nesom 2001b). One species, *Pseudognaphalium helleri*, is listed as a species of special concern for Tennessee with a state ranking of S2, based on its rarity within the state, although its global ranking of G4/G5 indicates that it is common in other parts of its range (Crabtree 2012).

Prior to initiation of this study, GenBank records for the complete nuclear ribosomal ITS region were reported for only three of the thirteen species of Gnaphalieae and Inuleae found in Tennessee. The GenBank records for *Antennaria* are relatively old and consist of separate ITS-1 and ITS-2 sequences rather than the entire ITS region as a single entity. The purpose of the study was to make a survey of sequence variation for the ITS region across Gnaphalieae and Inuleae that have been collected in the state of Tennessee. The goals included expanding the database of available samples for both barcoding and phylogenetic studies and assessing the value of this marker in identifying members of these tribes to genus or species level.

## MATERIALS AND METHODS

DNA was extracted from leaf samples either collected fresh or taken from herbarium specimens (Table 1). For most samples the DNeasy Plant Mini Kit (Qiagen, Valencia CA) was used, although some freshly collected samples were processed using the CTAB method (Doyle & Doyle 1987). PCR amplifications and sequencing of the ITS region followed protocols outlined by Schilling et al. (2007). A few samples required the use of the internal primers, "5.8S 79 for" and "ITS 5.8SR," for sequencing to obtain clean sequence, likely because of fungal contamination (Schilling et al. 2007). GenBank accession numbers are provided in Table 1. Although this study was not designed to undertake a rigorous phylogenetic analysis, parsimony analysis using the PAUP\* 4.0b10 program (Swofford 2003) was utilized to provide a convenient way to make a comparative visualization of the sequence results and incorporated sequences deposited at GenBank of conspecific or closely related samples. This included a sequence for *Anaphalis margaritacea* (L.) Benth., which though native to North America has not been clearly documented to occur in Tennessee outside of horticultural settings.

## RESULTS AND DISCUSSION

The complete ITS sequence region (ITS-1, 5.8S ribosomal DNA, ITS-2) varied in length in the newly reported Gnaphalieae samples from 633–641 bp. Sequences of *Pseudognaphalium* were consistently 633 bp; those of *Gamochaeta* 636–637 bp, and *Antennaria* showed the most length variation, with three of the four sampled species having a different length (636–638 bp). The ITS sequences for *Gnaphalium* (641 bp) and *Pluchea* (642 bp) were the longest of those sampled. There was no evidence in the electropherograms that any sample had multiple polymorphisms, either length or at individual sequence sites, which would provide evidence of recent or fixed interspecific hybridization.

Results of a phylogenetic analysis of the ITS sequence data for samples of Gnaphalieae are shown in Figure 1, with the single member of Inuleae used as the outgroup. Each genus was placed as monophyletic with moderate to strong bootstrap support. *Gamochaeta*, which was once considered to be part of *Gnaphalium*, was placed sister to *Facelis* and further sister to *Antennaria* (Fig. 1).

*Pseudognaphalium*, also formerly considered part of *Gnaphalium*, was placed as sister to *Anaphalis* with strong support.

Table 1 Plant material used for ITS barcoding studies of Gnaphalieae and Inuleae All specimens at TENN, collected in Tennessee

Species	DNA#	Genbank	Voucher info
<b>ANTENNARIA Gaertn.</b>			
<i>A. howellii</i> subsp. <i>neodioica</i> (Greene) R. Bayer	3444	JX524604	Sharp 26822, Sevier Co.
<i>A. parlinii</i> Fernald	3446	JX524605	Murrell 75, Polk Co.
<i>A. plantaginifolia</i> (L.) Hook.	2542	JX524601	Schilling 07-2542, Knox Co.
	3445	JX524602	Sharp 26281, Sevier Co.
<i>A. solitaria</i> Rydb.	3082	JX524603	Crabtree FSF-07-034, Marion Co.
<b>FACELIS Cass.</b>			
<i>F. retusa</i> (Lam.) Sch.Bip.	3083	JX524606	Beck 4671, Marion Co.
<b>GAMOCHAETA Wedd.</b>			
<i>G. argyrinea</i> G.L. Nesom	2766	JX524596	Schilling 08-2766, Knox Co.
	3084	JX524597	Phillippe 35455, DeKalb Co.
<i>G. pensylvanica</i> (Willd.) Cabrera	3085	JX524600	Browne 78, Shelby Co.
<i>G. purpurea</i> (L.) Cabrera	3443	JX524598	Estes 7859, Moore Co.
	3086	JX524599	Bresowar 122, Knox Co.
<b>GNAPHALIUM L.</b>			
<i>G. uliginosum</i> L.	3087	JX524592	Henry et al. s.n., Cocke Co.
<b>PSEUDOGNAPHALIUM Kirp.</b>			
<i>P. helleri</i> (Britton) Anderb.	3089	JX524593	DeSelm s.n., Franklin Co.
<i>P. micradenum</i> (Weath.) G.L. Nesom	3442	JX524594	Patrick 3813, Roane Co.
<i>P. obtusifolium</i> (L.) Hilliard & B.L.Burt.	2566	JX524595	Schilling CF-4, Unicoi Co.
<b>PLUCHEA Cass.</b>			
<i>P. camphorata</i> (L.) DC.	3088	JX524607	McNeilus 00-919, Fentress Co.



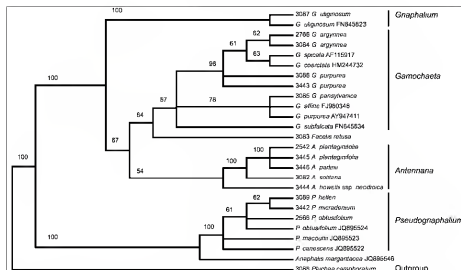


Figure 1. Single shortest tree from parsimony analysis of nuclear ribosomal ITS data showing relationships among species of Gnaphaleae from Tennessee. Bootstrap values shown above branches. Samples labeled by DNA number (Tennessee samples, Table 1) or GenBank accession number. The sample of *Pluchea camphorata* (Inuleae) was used as the outgroup.

**Antennaria.** Four species of *Antennaria* are recorded for Tennessee, of about 45 species total for the genus. The genus is clearly distinguished from other Gnaphaleae by at least 32 bp changes in the ITS sequences. The two samples of *A. plantaginifolia* were identical — the second sample tested was collected at the exact same site as the sample of *A. howellii* subsp. *neodioica* — and also identical to the sample of *A. parlinii*. All of the other species were separated by multiple changes, with 11 differences between *A. solitaria* and *A. plantaginifolia* and 25–27 differences between *A. howellii* subsp. *neodioica* and the other species. Complete ITS sequences (e.g., ITS-1, 5.8S rDNA, ITS-2) have not been previously deposited in GenBank for *A. parlinii*, *A. plantaginifolia*, or *A. solitaria*. Older records include individual ITS-1 and ITS-2 sequences for *A. plantaginifolia* and *A. solitaria*, but these were not retrieved in a BLAST search with standard parameters using newly obtained complete ITS sequences. The older sequences required several small gaps for alignment, which likely reflects the lower accuracy that was achieved using older technology.

**Facelis.** *Facelis* is represented in Tennessee by a single introduced species, *F. retusa*. The current report is the first record for the genus, which has 3–4 species total, in GenBank.

**Gamochaeta.** The three species of *Gamochaeta* documented from Tennessee were each distinctive for ITS sequence, with pairwise differences as follows: *G. argyrinea*–*G. pensylvanica*, 9 differences; *G. argyrinea*–*G. purpurea*, 4 differences; *G. pensylvanica*–*G. purpurea*, 5 differences. No intraspecific variation was encountered in the two samples each of *G. argyrinea* and *G. purpurea* (Table 1). Samples from GenBank labeled *G. purpurea* and *G. affine* were identical to our sample of *G. pensylvanica*, raising questions about whether they were accurately identified. Also distinct based on a GenBank sequence deposited for it was *G. coarctata* (Willd.) Kerguelen, which may be expected

to be found naturalized in western Tennessee (Guy Nesom, pers. comm.) The name for another GenBank sample, *G. spicata* (Lam.) Cabrera, is now considered to be a synonym for *G. coarctata* (Pruski & Nesom 2004), and sequences for the two GenBank samples were identical and differed at 3 positions from those of *G. argyrinea*. The distinctiveness of individual species of *Gamochaeta* is notable, especially considering that *G. argyrinea* was only recently recognized to be distinct from *G. purpurea* (Nesom 2004a). Similar results were obtained with a broader sampling of both species and samples of *Gamochaeta* by Cameron (2010), and the molecular results are further supported by detailed morphological analysis (Mac Alford and Kree Cameron, pers. comm.) Thus, a barcoding approach can be utilized to confirm the identity of samples of *Gamochaeta* collected in Tennessee.

**Gnaphalium.** *Gnaphalium* as currently interpreted is represented by a single recent collection of the apparently non-native *G. uliginosum* from eastern Tennessee. The ITS sequence from this sample was almost identical with a GenBank record for the species. It is clearly distinct from all other Gnaphalieae of Tennessee, differing by at least 51 bp changes.

**Pseudognaphalium.** The amount of interspecific variation for *Pseudognaphalium* was the least observed for any of the genera of Gnaphalieae in Tennessee. Samples of *P. helleri* and *P. micradenum* were identical to one another and differed by two changes from a sample of *P. obtusifolium*. A GenBank sequence for *P. obtusifolium* differed at a single position from our sample, and two other *Pseudognaphalium* sequences at GenBank (*P. macouni* and *P. canescens*, identification of the latter determined by G. Nesom) differed at three positions. These results suggested that species level diversification in *Pseudognaphalium* might be relatively recent, similar to what has been observed for other Asteraceae genera in eastern North America, such as *Helianthus* and *Solidago*.

**Pluchea.** A single species of *Pluchea* out of the 40 or more species of the genus is native to Tennessee. The ITS sequence is the first record for the species in GenBank, and it is significantly different (minimum of 45 bp differences and 6 gaps) from other species of the genus represented in GenBank.

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## NEW VASCULAR PLANT COUNTY RECORDS FROM CENTRAL TEXAS

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### ABSTRACT

Ten species of vascular plants are reported as new to Williamson, Burnet, Kendall, and/or Bastrop counties, Texas. The species are *Sisyrinchium angustifolium*, *Erigeron philadelphicus*, *Castilleja indivisa*, *Nolina texana*, *Forestiera pubescens*, *Parietaria pensylvanica*, *Zanthoxylum clava-herculis*, *Papaver somniferum*, *Ziziphus zizyphus*, and *Aesculus pavia*.

The author and Marie Greener collected 247 herbarium specimens in central Texas counties (Williamson, Burnet, Kendall, and Bastrop) from 26 March to 4 April 2011. Among these were a number of species not previously reported from those counties. A complete set of the specimens is housed at NY and a partial set of duplicates was distributed to TEX/LL. County distributions were determined using the Atlas of the Vascular Plants of Texas (Turner et al. 2003).

#### *Sisyrinchium angustifolium* Mill. (Iridaceae)

Williamson Co.: Between Liberty Hill and Leander, along the San Gabriel River, 30.623441N, 97.875048W ( $\pm 50$  m), ca 267 m, 26 Mar 2011, *Atha & Greener 9514* (NY, TEX). Herbs; flowers purple with yellow center. River bluffs and floodplain.

This native North American species is common from Nova Scotia to Ontario, south to Minnesota, Kansas, Texas, and Florida. It occurs sporadically through east, central, and north Texas (Turner et al. 2003). Its apparent absence from Williamson County is probably a collecting or reporting artifact.

#### *Erigeron philadelphicus* L. (Asteraceae)

Williamson Co.: Between Liberty Hill and Leander, along the San Gabriel River, 30.623441N, 97.875048W ( $\pm 50$  m), ca 267 m, 26 May 2011, *Atha & Greener 9515* (NY). Herbs; rays white. River bluffs and floodplain.

This native species occurs nearly throughout North America; absent only from Greenland, Labrador, Nunavut, Alaska, Arizona and Utah. In Texas it is concentrated around the urban centers of Houston, Austin, Waco, and Dallas-Ft. Worth, with scattered occurrences west to Kimble County (Turner et al. 2003).

#### *Castilleja indivisa* Engelm. (Scrophulariaceae)

Burnet Co.: Town of Marble Falls, corner of Ave N and Colorado St., 30.566901N, 98.287053W ( $\pm 25$  m), ca 238 m, 30 Mar 2011, *Atha & Greener 9586* (NY). Herbs; stems purple; bracts green proximally, orange distally; flowers yellow green. Mown lot with few trees.

This species is endemic to Arkansas, Louisiana, Oklahoma, and Texas. In Texas it occurs nearly throughout the eastern half of the state as far west as Tom Green County (Turner et al., 2003).

*Nolina texana* S. Watson (Agavaceae)

Burnet Co.: N of Marble Falls along US 281, at intersection with Coach Rd., 30.606326N, 98.267337W ( $\pm 25$  m), ca 268 m, 30 Mar 2011, *Atha & Greener 9593* (NY, TEX). Herbs; flowers purplish. Rocky outcrop, relatively dry for area.

This is in part a Chihuahuan desert species, ranging from central Texas and southwestern Oklahoma, west to southeastern Arizona and northern Mexico. In Texas it is known from much of the Edwards Plateau and Trans-Pecos but has yet to be collected from several counties (e.g., Bexar, Kendall, Hays, Mason, Kimble).

*Forestiera pubescens* Nutt. (Oleaceae)

Burnet Co.: E of Granite Shoals, N of Lake LBJ and S of Ranch Road 1431, 30.583122N, 98.363923W ( $\pm 25$  m), ca 271 m, 31 Mar 2011, *Atha & Greener 9601* (NY). Trees. Granite hilltop with savanna-like vegetation.

This species is native throughout much of the Edwards Plateau and northern plains and cross timbers region. Its apparent absence in Burnet and Blanco counties is undoubtedly an artifact of collecting or reporting.

*Parietaria pensylvanica* Muhl. ex Willd. (Urticaceae)

Kendall Co.: Ca 18 km N of Boerne on Guadalupe River at Hwy 1376, 29.957312N, 98.717402W ( $\pm 25$  m), 374 m, 31 Mar 2011, *Atha & Greener 9647* (NY). Herbs, stems reddish. Limestone terraces and alluvium along river.

This species is native throughout much of Texas. Its apparent absence in Kendall county is undoubtedly an artifact of collecting or reporting.

*Zanthoxylum clava-herculis* L. (Rutaceae)

Bastrop Co.: Ca 10.5 km NW of Bastrop, along the Colorado River at Tx Hwy 71, 30.168058N, 97.403063W ( $\pm 25$  m), ca 107 m, 2 Apr 2011, *Atha & Greener 9673* (NY, TEX). Trees 4 m tall. Floodplain of the Colorado River.

This native species is widespread throughout nearly all of the eastern half of Texas, down to Refugio, but is nowhere abundant. It is not commonly collected, perhaps due to its spiny habit.

*Papaver somniferum* L. (Papaveraceae)

Bastrop Co.: Ca 10.5 km NW of Bastrop, along the Colorado River at Tx Hwy 71, 30.168058N, 97.403063W ( $\pm 25$  m), ca 107 m, 2 Apr 2011, *Atha & Greener 9674* (NY). Herbs; sap clear. This plant in weedy strip of land near boat ramp. Floodplain of the Colorado River.

This plant was found growing at the edge of a paved road along a public-right-of-way. It probably escaped from cultivation by seed dispersal, perhaps from a nearby RV campground. No other *Papaver* plants were seen in the vicinity.

*Ziziphus zizyphus* (L.) Karst. (Rhamnaceae)

Bastrop Co.: Town of Bastrop along N Main Street at old railroad crossing over creek, 30.131989N, 97.320977W ( $\pm 25$  m), 106 m, 3 Apr 2011, *Atha & Greener 9681* (NY, TEX). Trees ca 2.5 m tall. There are hundreds of these young trees in an area about 100 square meters. Secondary woods along abandoned railroad.

This introduced species is not common in Texas. It is reported from only nineteen counties, these widely scattered from Jeff Davis, Hidalgo, Travis, and Grayson counties. It may be in the process of expanding its range.

*Aesculus pavia* L. (Hippocastanaceae)

Bastrop Co.: 6.7 km NW of Smithville along Tx Hwy 71, 30.055529N, 97.202876W ( $\pm$  25 m), 112 m, 4 Apr 2011, *Atha & Greener 9734* (MO, MU, NY, TEX, W). Shrubs 1.5 m tall; calyx red; upper petals yellow-orange at the base, pink or salmon at the tips; anthers yellow. Dry secondary woods.

This beautiful native shrub is common throughout the southeastern USA from Virginia to Texas. Its occurrence in Bastrop County is not surprising and it is expected in Burleson, Lee, Caldwell, and Guadalupe counties as well.

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## VALIDATION OF A SCIENTIFIC NAME FOR THE TAHITIAN LIME

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### ABSTRACT

The name *Citrus latifolia* Tanaka, commonly used for the economically important Tahitian lime, is found to have been invalidly published, without a Latin description or citation of any basionym. Likewise, publications referring to a presumed basionym, *C. aurantifolia* (Christm.) Swingle var. *latifolia* Tanaka ex Yu. Tanaka, do not effect valid publication for that entity nor reference to any synonym that could be used. A diagnosis and type citation are here provided to validate a scientific name for the Tahitian lime, *Citrus ×latifolia* Tanaka ex Q. Jiménez.

**KEY WORDS:** *Citrus latifolia*, limón mesino, Persian lime, Rutaceae, Tahitian lime.

*Citrus ×latifolia* Tanaka is the name in current use for a species of economic importance commonly known in the English-speaking world as the Persian or Tahitian lime (see, e.g., Mabberley, 2008). However, in the process of editing the Rutaceae treatment for the *Manual de Plantas de Costa Rica*, we have found that *C. latifolia* Tanaka (1951: 140), often cited as *C. latifolia* (Tanaka ex Yu. Tanaka) Tanaka, was published without a Latin description or mention of any basionym and, as such, is invalid and cannot be considered as either a new taxon name or a new combination.

The oft-cited parenthetical authorship refers to a presumed basionym, *Citrus aurantifolia* (Christm.) Swingle var. *latifolia* Tanaka ex Yu. Tanaka (1948). The ostensible protologue of the varietal name includes extensive Japanese text, a detailed illustration, and a bibliography, but apart from binomials and trinomials, no Latin, which was required at the time (validation by means of illustrations was only permitted before 1908; see McNeill et al., 2006: Art. 42.3). Tanaka (1948: 57, 60) cited a specific page in Tanaka (1938), which act could conceivably have resulted in the validation of the name, but the last-mentioned paper also includes no Latin text, merely the name “*Citrus aurantifolia* Swingle var. *latifolia* Tanaka” in a skeletal list, with a few Japanese characters.

Consulting all the other references we could track down that might contain or lead to a validly published version of either of these names (e.g., Tanaka 1932, 1939), we came up empty-handed. Furthermore, we know of no synonym that could be used in place of *Citrus ×latifolia*. Therefore, in order to provide a valid name for a species of *Citrus* to be treated in the *Manual de Plantas de Costa Rica* and which is an important commercial crop in Costa Rica (where it is commonly known as limón mesino or limón persa) and many other parts of the world, we here provide a diagnosis and cite a type specimen for *Citrus ×latifolia* (now generally acknowledged as a hybrid involving *C. ×aurantifolia*), the name first used by Tyōzaburō Tanaka (1885–1976):

**CITRUS** ×**LATIFOLIA** Tanaka ex Q. Jiménez, **sp. nov.** **TYPE:** COSTA RICA. **Heredia:** Cantón de Santo Domingo. Dto. Turés. Calle La Rinconada, en cafetales y lotes por el Río Turés, 9° 60' N, 84° 04' W, 1200 m, 20 Feb 2006, *B. Hammel & I. Pérez 24125* (holotype: MO; isotypes: CR, INB). Figures 1–3.

Similar to *Citrus* ×*aurantiifolia* (Christm.) Swingle (Key lime, lime, limón criollo, etc.) but differing by its lack or near lack of thorns and larger fruits (5.5–8 × 6–7.5 cm, vs. 4–6 × 4–5 cm) with a thicker rind (3–7 mm, vs. 1–3 mm), lacking seeds, and with less acidic, non-bitter juice.



Figure 1. *Citrus* ×*latifolia*. Close-up of flowering branch showing buds, open flower, and young fruit (*Hammel & Pérez 24125*); inset showing spines and leaf bases. Scale bar = 2 cm.





Figure 2. *Citrus ×latifolia*. Flowering and fruiting branches, with fruit sliced longitudinally (Hammel & Pérez 24125); inset showing glandular dots (largest ca. 0.3 mm diam.). Scale bar = 5 cm.



Figure 3. *Citrus × latifolia*. Fruiting branch on tree (Hammel & Pérez 24125). Scale bar = 5 cm.

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## GUIDE TO AGAVE, CINNAMOMUM, CORYMBIA, EUCALYPTUS, PANDANUS, AND SANSEVIERIA IN THE FLORA OF FLORIDA

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### ABSTRACT

Several species-rich groups of non-native taxa occur in Florida and can be difficult to identify. This synopsis provides identification keys and brief discussions of the naturalized species of six genera in Florida: *Agave*, *Cinnamomum*, *Corymbia*, *Eucalyptus*, *Pandanus*, and *Sansevieria*. Of the genera treated here, only one taxon is presumed to be a pre-Columbian native, *Agave decipiens*, and all others are considered exotic. *Agave neglecta* is treated as a synonym of *A. weberi*. *Cinnamomum burmannii*, *Pandanus odorifer*, and *Sansevieria trifasciata* are here reported for the first time in the flora of Florida. Lectotypes are designated for *A. decipiens* and *A. sisalana* var. *armata*. Many of the genera possess a convoluted taxonomy and are in need of a modern taxonomic revision. Thus, for the most part, heterotypic synonyms are not listed except for two synonyms discussed in *Agave*. All cited specimens examined are from Florida. All photos are by the author unless indicated otherwise.

**KEY WORDS:** *Agave*, *Cinnamomum*, *Corymbia*, *Eucalyptus*, *Pandanus*, *Sansevieria*

**AGAVE L., Sp. Pl. 1: 323. 1753. TYPE:** *Agave americana* L.

The genus *Agave* contains ca. 200 species endemic to the Americas with its center of diversity in Mexico (Gentry 1982). Various species of *Agave* are used (e.g. Gentry 1982; Colunga-GarcíaMarín and May-Pat 1993) as a food (cabezas), sweetener (agave nectar), beverage (agua miel, pulque, tequila), fiber (sisal, henequen), medicine (steroidal saponinins), soap (saponins), and landscape plant. The sap of the tequila agave, *A. angustifolia* Haw. subsp. *tequilana* (F.A.C. Weber) Valenz.-Zap. & Nabhan, and the popular ornamental *A. americana* can cause contact dermatitis due to calcium oxalate crystals (Salinas et al. 2001) which are likely present in other taxa. The use of *Agave* as a food in Mexico has been documented as early as 7000 B.C. (Callen 1965). There are accounts of *Agave* in cultivation in Europe as early as the 1500s (Drummond & Prain 1906).

After flowering, the leaves of *Agave* wither and the rosette eventually dies. Only the above-ground stem of *Agave* is strictly semelparous, as the plants are also surculose, sending out underground shoots. Clonal reproduction by the formation of small plantlets, or bulbils, in the inflorescence is also common. Several hundred to thousands of bulbils may be produced from an inflorescence (Szarek et al. 1996). Vegetative reproduction is the only means of spreading for some naturalized taxa of *Agave* in Florida.

Because plant parts of *Agave* are typically bulky and succulent, herbarium specimens are often prepared from smaller pieces and fragments which are inadequate for identification. For identification it is necessary to have full-length mature leaves and ideally a photograph of the mature plant as well. The largest plants (and largest leaves) present should be sampled. The abaxial portion of thick, succulent leaves should be gutted leaving the upper epidermis and leaf margins intact (Gentry 1982) to help maintain their shape during drying and pressing. If leaves are not sufficiently

guttated they may split and become misshapen upon drying. Young plants, bulbils, partial leaves, and inflorescence bracts are extremely difficult to identify to species and should only be collected if accompanying specimens with mature leaves are included.

Two subgenera of *Agave* can be recognized. All species in the Florida flora belong in *A.* subg. *Agave*, characterized by paniculate, umbellate inflorescences. Spikelike inflorescences characterize *Agave* subg. *Littaea* (Tagl.) Baker.

# KEY TO *AGAVE* IN FLORIDA

Note: Spines are delimited by the darkened, hardened, and sclerified tissue that contrasts with the greener and softer leaf tissue.

1. Terminal spine decurrent (sclerified spine tissue extending down margins of leaf)
  2. Leaves with stout marginal spines throughout ..... *Agave americana*
  2. Leaves entire or with marginal prickles only at the base of the leaves ..... *Agave weberi*
1. Terminal spine abrupt, truncate
  3. Most or all leaves recurved ..... *Agave desmettiana*
  3. Most leaves, and especially young ones, straight, erect
    4. Leaves entire or with occasional sporadic spines or marginal spines weak, usually  $\leq 3$  mm long and  $< 4$  mm wide ..... *Agave sisalana*
    4. Leaves with marginal spines throughout; marginal spines fairly robust, usually  $> 3$  mm long, to 8 mm wide
      5. Leaves virid, bright green and not glaucous ..... *Agave decipiens*
      5. Leaves variegated or blue-green and glaucous ..... *Agave angustifolia*

*Agave americana* L., Sp. Pl. 1: 323. 1753. *Aloe americana* (L.) Crantz, Inst. Rei Herb. 1: 466. 1766. LECTOTYPE (designated by Howard 1979): *Herb. Linnaeus*, 443.1 (LINN). Figure 1.

*Agave americana* is the only naturalized *Agave* in Florida not known to produce bulbils in the inflorescence, although the species still vegetatively spreads by suckers (scurlose). Although Small (1933) mentioned that *A. americana* is found in hammocks and pinelands, the known specimens demonstrate this species spreading only locally from cultivation. *Agave americana* subsp. *protamericana* Gentry represents the wild taxon from which the cultivated form *A. americana* subsp. *americana* putatively arose (Gentry 1982; Reveal & Hodgson 2002). Two varieties of *A. americana* subsp. *americana* were recognized by Reveal and Hodgson (2002). Both are commonly cultivated and may spread locally. One variety is *A. americana* var. *americana*, which includes a cultivar with reflexed, variegated leaves (Fig. 1) and may produce capsules. The other variety is *A. americana* var. *expansa* (Jacobi) Gentry, which has erect, blue-gray leaves and has not been observed to produce capsules (Fig. 1).

Specimens examined: **Charlotte Co.:** A.R. Franck & B. Upcavage 1859 (USF). **Sarasota Co.:** A.R. Franck 1868 (FLAS, USF).



Figure 1. *Agave americana*. A,C – habit; B,D – decurrent terminal leaf spine. A,B – *A. americana* var. *americana*, Sarasota Co., Florida; C,D – *A. americana* var. *expansa*, Charlotte Co., Florida.

*Agave angustifolia* Haw., Syn. Pl. Succ. 72. 1812. **NEOTYPE** (designated by García-Mendoza & Chiang 2003): **MEXICO. Oaxaca**. Distr. Huajuapán de León, Mun. San Andrés, 3 km N of Tutla, 29 Jun 1992, A. García-Mendoza & F. Palma 5654 (MEXU). Figures 2–3.

*Agave angustifolia* is a highly variable species from which many other taxa are likely derived, such as *A. amaniensis* Trel. & W. Nowell, *A. angustifolia* subsp. *tequilana*, *A. decipiens*, *A. fourcroydes* Lem., and *A. sisalana*.



Figure 2. *Agave angustifolia*. A – fruits, B – inflorescence, C – flowers, D – terminal leaf spine. A,D - Sarasota Co., Florida (Franck 1744); B,C - Sarasota Co., Florida (Franck 2261).



Figure 3. *Agave angustifolia*. A – inflorescence, B – terminal leaf spine, C – flowers. A,B,C – Sarasota Co., Florida (Franck 2263).

The lectotype (perhaps actually a neotype) designated by Gentry has been discounted as incongruent with the protologue (Garcia-Mendoza & Chiang 2003). *Agave angustifolia* was once erroneously synonymized with *A. vivipara* L. of the Leeward and Venezuelan islands (Hummelinck 1938; Garcia-Mendoza & Chiang 2003), a different species with comparably short, wide, recurved leaves possibly related to *A. karatto* Mill. of the Lesser Antilles (Trelease 1913; Rogers 2000). Two forms of *Agave angustifolia* have been found naturalized in Florida. One is a common cultivar which



has variegated leaves and may produce both bulbils and capsules in the inflorescence (Fig. 2). Another form has glaucous-green leaves and was observed to produce bulbils only (Fig. 3)

Specimens examined. **Highlands Co.** *W.S. Judd & D.W. Hall 5044* (FLAS) **Miami-Dade Co.** *G.N. Avery 1581* (FLAS, FTG) **Sarasota Co.** *A.R. Franck 1744, 1748, 1861, 1862, 2261* (USF), *A.R. Franck 1747, 2263* (FLAS, USF)

*Agave decipiens* Baker, Bull. Misc. Inform. Kew 1892 (67–68) 183. 1892. **LECTOTYPE** (designated here) **USA. Florida** Palm Beach Co. Lake Worth, May 1892, *C.R. Dodge s.n.* (K) Fig. 4.

*Agave decipiens* is the only native *Agave* in Florida, usually found in coastal hammocks, “always most abundant in the wilds” (Dodge 1893, p. 29). This species seems to only slightly differ from *A. angustifolia* (Zona 2001). Although many species of *Agave* may produce a noticeable trunk under certain conditions, it is especially common and pronounced in *A. decipiens* (Fig. 4).

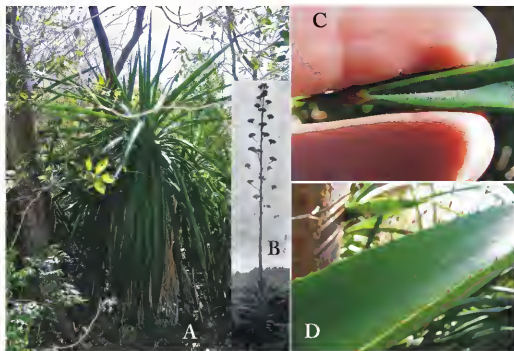


Figure 4. *Agave decipiens*. A – habit, B – inflorescence, C – terminal leaf spine, D – marginal leaf spines. A,C,D – Lee Co., Florida, B – Santa Barbara Co., California (Fig. 72, Berger 1915).

As noted by Zona (2001), Gentry (1982) indicated a later published illustration to be a lectotype, which would actually be a neotype. The protologue of *A. decipiens* indicates the study of several specimens (“these and other specimens”) including some sent by Dodge from at least two locations, Lake Worth (Palm Beach Co.) and Biscayne Bay (Miami-Dade Co.). Thus there is no definitive holotype (cf. Zona 2001). Berger (1915) cited material from Dodge at K but only mentioned Biscayne Bay and did not indicate a type. Three collections were found at K which were dated before the protologue (Jul-Aug 1892). A two-sheet specimen consisting of a leaf and several

flowers sent to K by Dodge from Lake Worth (dated May 1892) bears an anonymous handwritten note reading "Type specimen" This two-sheet specimen of *A. decipiens* from Lake Worth is not known to have been declared as a type in any publication and is here designated as the lectotype. The other specimen at K from Dodge (received March 1892) was collected from Coconut Grove which lies on Biscayne Bay. The specimens at US from Dodge are dated either "1892" or "Feb 1892" and cite the location as "Southern Florida." The US specimens cannot be considered the same gathering nor isolectotypes. The other collection at K dated before the protologue was *Curtiss 2836*, received April 1883.

Specimens examined **Charlotte Co.** *S.W. Braem DP0078* (USF). **Collier Co.** *E. Jensen & C. Olson DW0001* (USF), *A. Bishop DW0007* (USF), *O.K. Lakela 29446* (USF), *P.C. Standley 12812* (US). **Lee Co.** *A. Bishop LK0050* (USF), *S. Todd 54* (USF), *B.F. Hansen & J. Hansen 5698* (USF), *A.R. Franck & S.W. Braem 2611, 2612, 2613, 2614, 2615, 2617, 2619* (USF), *S.W. Braem s.n.* (USF), *J. Beckner 1756* (FLAS), *W.C. Brumbach 6086* (FLAS), *T. Hunt s.n.* (FLAS). **Martin Co.** *J. Popenoe 1152* (FTG). **Miami-Dade Co.** *S. Zona 830, 831* (FTG), *A.H. Curtiss 2836* (K, P), *C.R. Dodge s.n.* (K). **Monroe Co.** *R.W. Long et al 2715* (USF), *E.P. Killip 31696* (FLAS, K, P), *Dickson s.n.* (FTG), *J.K. Small 7367* (FLAS). **Sarasota Co.** *O.K. Lakela & R.W. Long 27562* (USF), *O.K. Lakela & R.W. Long 28146* (FLAS, USF), *C.C. Coons s.n.* (FLAS).

*Agave desmettiana* Jacobi, *Hamburger Garten-Blumenzeitung* 22: 217, f. 32. 1866. **NEOTYPE** (designated by Gentry 1982). **MEXICO.** *Sinaloa* Gusave, 8 Feb 1952, *H.S. Gentry 11569* (US, isoneotypes, DES, MEXU). Figure 5

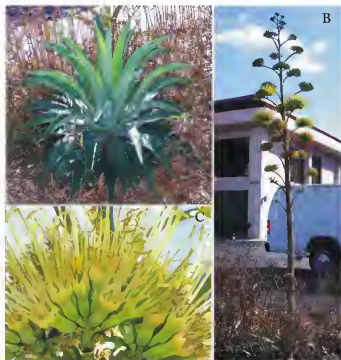


Figure 5. *Agave desmettiana*. A – habit; B – inflorescence, C – flowers. A,B,C – Sarasota Co., Florida.

*Agave desmettiana* is a diminutive species with relatively short leaves, a short inflorescence, and short suckers (Fig. 5). There are forms that may have marginal spines or entire margins.

Specimens examined: Lee Co.: *W.C. Brumbach* 7798, 8459 (FLAS). Sarasota Co.: *A.R. Franck* 1790 (USF).

*Agave sisalana* Perrine, Congr. Doc. (25th Congr.) 564: 87. 1838. *Agave rigida* Mill. var. *sisalana* (Perrine) Engelm., Trans. Acad. Sci. St. Louis 3: 316. 1875. NEOTYPE (designated by Gentry 1982): MEXICO. Chiapas. Ocosocoutla, cultivated as fence row and fiber plant, 22 Mar 1957, *H.S. Gentry* 16434 (US; isoneotype, DES). Figure 6.

*Agave sisalana* Perrine var. *armata* Trel., Mem. Natl. Acad. Sci. 11: 49. 1913, syn. nov. LECTOTYPE (designated here): JAMAICA. St. Andrew Par.: Hope Gardens, May 1907, *W. Harris* X (MO, accession #2147690; also shown in plate 111, Trelease 1913).

*Agave sisalana* is a pentaploid (Doughty 1936) cultivated for its fiber. This species was introduced to Florida in the 1830s by Dr. Henry Perrine (Robinson 1942). Soon, thereafter, this species had spread throughout much of south Florida for use as a fiber and an ornamental (Dodge 1893). In 1892, 5000 plants were exported from Florida to India (Drummond & Prain 1906). Part of the advantage of using *A. sisalana* for fiber is that it often has entire leaves devoid of marginal spines. Occasionally, a leaf with a few marginal spines can be found on a rosette where all other leaves are entire. Plants with weak marginal spines throughout the margins of all leaves (*A. sisalana* var. *armata*) are frequently found and have been documented in Jamaica (Trelease 1913), Florida (Fig. 5), and Spain (Guillot Ortiz & van der Meer 2006). The bulbils of *A. sisalana* often show weak spines (Pinkerton & Bock 1969).

Like *Agave sisalana*, *A. fourcroydes* is a pentaploid cultivar also used for its fiber (Doughty 1936). These two species can be difficult to distinguish. The traditional view is that *A. fourcroydes* has marginal spines and *A. sisalana* has entire leaves (Vidal 1925). However, this distinction is not entirely useful because of numerous examples of *A. sisalana* plants with marginal spines throughout all leaves of the plant. Furthermore, an entire-leaved form of *A. fourcroydes* (*A. fourcroydes* var. *espiculata* Dewey (1929)) has also been described.

Because *Agave sisalana* is usually regarded as having only entire leaves, plants with weak marginal spines in Florida have been identified as either *A. decipiens* or *A. fourcroydes*. The leaves of *A. decipiens* have larger marginal spines and appear pure green. The leaves of *A. sisalana* are often lightly glaucous-green.

It seems the only useful character for separating *Agave fourcroydes* and *A. sisalana* is the terminal spine. Leaves of *A. fourcroydes* have a rather stout terminal spine with an abrupt point whereas those of *A. sisalana* have a thinner terminal spine with a long-tapering point. It has also been suggested that *A. fourcroydes* has grayer leaves than *A. sisalana* (Trelease 1913), though several types of *A. fourcroydes* appear to have similarly green leaves (Colunga-GarcíaMarín et al. 1996; Colunga-GarcíaMarín & May Pat 1997; Colunga-GarcíaMarín et al. 1999).

It is questionable whether *Agave fourcroydes* and *A. sisalana* should be treated as species and it may be more appropriate to treat them as varieties or cultivars of *A. angustifolia*. All three species are able to hybridize and have similar geographic origins (Perrine 1838; Vidal 1925; Dewey 1931; Lock 1962). Several forms of *A. fourcroydes* have been morphologically characterized and distinguished from *A. angustifolia* (Colunga-GarcíaMarín et al. 1996; Colunga-GarcíaMarín & May Pat 1997; Colunga-GarcíaMarín et al. 1999; Piven et al. 2001; Robert et al. 2008).



Figure 6. *Agave sisalana*. A – habit (marginally-spined form on the left, entire-leaved form on the right), B – sucker inflorescence, C – normal inflorescence, D – marginally-spined leaves, E – base of inflorescence. A,D – Hillsborough Co., Florida (Franck & Upcavage 2259), B,C,E – Sarasota Co., Florida (Franck 1746).

Gentry (1982) allied *Agave sisalana* with *A. weberi* because both have only weak marginal spines. However, *A. weberi* appears to be unrelated with its decurrent terminal spine, wider leaves, and closely-spaced basal prickles. *Agave amanienensis*, a glaucous, diploid form has been separated from *A. sisalana* (Trelease & Nowell 1933). It seems probable that *A. amanienensis* is synonymous to or derived from *A. sisalana* as it was described from Tanzania where *A. sisalana* had been cultivated since 1893 (Lock 1962).

The marginally-spined *Agave sisalana* var. *armata* is here recognized as a synonym of *A. sisalana*. A leaf specimen of *A. sisalana* var. *armata* at MO is designated as the lectotype. A letter with an accompanying photograph from W. Harris (MO, accession #2147681) states that “entire and prickly forms” of *A. sisalana* were intermixed. At Egmont Key, Hillsborough Co. in Florida, a

similar situation was encountered, in which entire-leaved *A. sisalana* was intermixed with marginally-spined forms, without any other noticeable differences (Fig. 6).

The flower specimens of *Harris X* at MO (accessions #2147691, #2147692, #2147692, and #3377526), cannot be reliably confirmed to be from the same plant or gathering as the lectotype because one of the sheets (MO, accession #3377526) contains an illustration which states "flowers of the spine-less leaf *Agave rigida* var. *sisalana*". The flower specimens of *Harris X* at MO are excluded from the lectotype. Trelease (1913) also cited the specimen Britton & Millspaugh 5936 for *A. sisalana* var. *armata*, which has been databased at MO (accession #2147672) but was unable to be located.

Although *Agave sisalana* appears to be exclusively bulbiferous without capsules, it is apparently possible to find capsules with viable seeds under certain conditions such as high elevation (900–1800 m), low night-time temperatures, and a cut-back inflorescence (Lock 1962). A photograph of the capsules and seeds was made by Trelease (1913). This species also has the ability to send up suckers that emerge to form short inflorescences without a rosette of leaves (Dodge 1893; Fig. 6).

*Agave sisalana* Perrine was sufficiently described with a diagnosis by Perrine to effect valid publication so the authorship citation *A. sisalana* Perrine ex Engelm. is unnecessary.

Specimens examined: **Brevard Co.:** *W.T. Gillis 6886* (FLAS, FTG), *P.L. Howell 917* (USF). **Collier Co.:** *O.K. Lakela et al. 28005* (USF), *O.K. Lakela 28529* (FSU, USF), *O.K. Lakela 29447* (USF), *B.F. Hansen & R.P. Wunderlin 11851* (FLAS, FTG, USF), *B.F. Hansen et al. 11836* (FLAS, FTG, USF). **Hillsborough Co.:** *R.P. Wunderlin et al. 5953* (USF), *A.R. Franck & B. Upcavage 2557, 2558, 2559, 2560, 2561, 2562* (USF), *R.W. Long et al. 2946* (USF), *E. Jensen & C. Olson EK0009, EK0010* (USF). **Lee Co.:** *S. Todd 76* (USF), *G.R. Cooley 2435* (USF), *W.C. Brumbach 9199* (NY, USF), *E. Jensen & C. Olson CC0139* (USF), *A.R. Franck & S.W. Braem 2603, 2618* (USF), *W.C. Brumbach 8459, 8954* (NY), *E. Jensen et al. MK0044* (USF), *A. Bishop & B.K. Holst CC0044* (USF), *A.R. Franck & S.W. Braem 2620* (USF), *S.W. Braem s.n.* (USF), *E. Gandy & B. Ochoa LK0102* (USF); *S. Brown s.n.* (FLAS). **Manatee Co.:** *E. West s.n.* (FLAS). **Martin Co.:** *J. Popenoe 1033* (FTG). **Miami-Dade Co.:** *B. Tan & N. Raymond TP59* (FLAS), *W.S. Judd 7087* (FLAS), *A.H. Curtiss 5614* (NY). **Monroe Co.:** *R.W. Long et al. 1860* (USF), *A.R. Franck 2507* (USF), *C.C. Parry s.n.* (MO), *A.H. Curtiss 5644* (FLAS, NY), *D.B. Ward & S.S. Ward 1185* (FLAS, FSU), *L. Garbarini s.n., 15 Nov 1967* (FTG), *I.A. Badia s.n.* (FTG), *B.C. Schmidt 48* (FTG), *Dickson s.n., 13 Jan 1952* (FTG). **Pinellas Co.:** *C. vanHoek & B. Fortner CI0243* (USF), *A. Schmidt et al. s.n.* (USF). **Sarasota Co.:** *E. Jensen & C. Olson OS0566* (USF), *A.R. Franck 1419, 1867* (USF), *A.R. Franck 1746* (FLAS, USF), *J. Beckner 1717* (FLAS).

*Agave weberi* F. Cels ex J. Poiss., Bull. Mus. Hist. Nat. (Paris) 7: 231. 1901. NEOTYPE (designated by Gentry 1982): USA. Texas. Webb Co.: between Catarina and Laredo along route 83, 4 Jun 1963, *H.S. Gentry et al. 20003* (US; isoneotypes, DES, MEXU). Figure 7.

*Agave neglecta* Small, Fl. S.E. U.S. 289. 1903, syn. nov. LECTOTYPE (designated by Gentry 1982): USA. Florida. Lake Co.: cultivated at Eustis [U.S. Subtropical Laboratory], Jul 1895, *H.J. Webber s.n.* (MO; isolecotypes, ASU, NY).

*Agave neglecta*, long considered an enigmatic endemic of Florida, is here synonymized with *A. weberi*. With the NY isolecotype of *A. neglecta* is a note from Gentry dated Feb 1980 stating "may be synonymous with *A. weberi* Cels." Gentry (1982) only marginally separated *A. neglecta* and *A. weberi* with subtle morphological differences. The protologue of *A. neglecta* describes leaves and capsules very similar to *A. weberi*, "blades glaucous . . . recurved at maturity . . . margins armed with

minute close-set teeth" (Small 1903). It seems *A. neglecta* was described due to the lack of knowledge of any other similar *Agave* as *A. weberi* was never mentioned by Small (1903, 1933)

Although Gentry (1982) separated *Agave neglecta* and *A. weberi*, the characters do not seem to hold up to scrutiny. The inflorescence height in the protologue is certainly an estimate, "13 m tall, panicle about 30 dm high" (Small 1903), later modified to "panicle 3 m long, scape three or four times as long" (Small 1933). Gentry (1982), whose description appears to have been supplemented by a photograph of a plant from Pass-a-Grille, Pinellas Co., distinguished *A. neglecta* with an inflorescence 8–10 m tall and that of *A. weberi* as 3–10 m tall but noted that both species had tall peduncles that often topple (Fig. 7). The flowers of the lectotype specimens of *A. neglecta* are very much withered and appear to have been collected at post-anthesis or at least were not pressed soon after collection. The withered lectotype flowers match the measurements of the protologue, "55 mm long" (Small 1903), but should be regarded as inappropriate measurements for freshly opened flowers. Gentry (1982) distinguished *A. weberi* as having longer flowers, "65–80 mm". The terminal spine of *A. neglecta* was described as 2.5 cm long (Small 1933, Gentry 1982) and that of *A. weberi* as 2.5–5 cm long. The terminal spine length of *A. neglecta* might only be based on two leaf collections dated before the protologue, that of the lectotype (MO) and perhaps McCarty s.n. (MO). It is doubtful these two leaves represent the maximal length of the terminal spine.

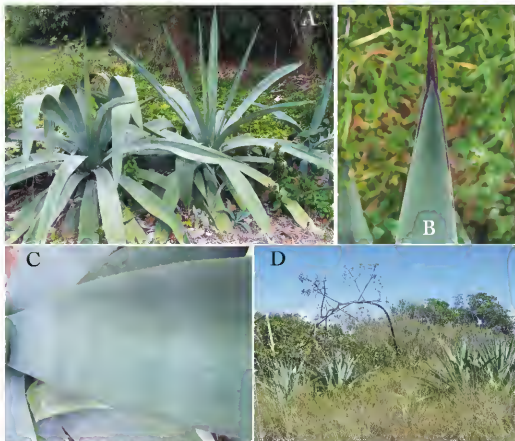


Figure 7. *Agave weberi*. A – habit, B – decurrent terminal leaf spine, C – adaxial leaf base with marginal prickles, D – near toppled inflorescence with fruits. A, C – Sarasota Co., Florida (Franck 1864), B – Sarasota Co., Florida, D – Charlotte Co., Florida (Franck 2645)

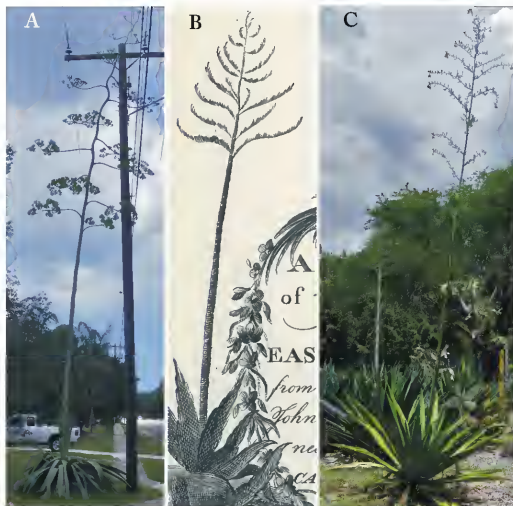


Figure 8 Comparison of three inflorescences of Agavaceae. A – *Agave weberi* in Sarasota Co., Florida; B – unknown Agavaceae, “A Map of the East Coast of Florida” in Bartram (1791), C – *Furcraea* sp. in Santo Domingo, Dominican Republic.

Small (1933) later states that *Agave neglecta* occurs in “pinelands, hammocks, and kitchenmiddens”, “is extensively planted for ornament in Florida”, and “like *A. decipiens* this century plant thrives on kitchenmiddens and aboriginal village sites.” The habitat remarks do not appear to constitute evidence for *A. neglecta* being native because *A. americana* is also stated as being naturalized and found in “hammocks, pinelands” (Small 1933). It is not clear what the habitat remarks were based on as I am not aware of any herbarium specimens or published encounters of *A. neglecta* from Small. His statements may be based on his assertion that the *A. vivipara* mentioned by Bartram (1791) was *A. neglecta* (Small 1933), though there is no way to make a confident identification based on the description “scapes arose erect near 30 ft high when their seeds are ripe [probably bulbils, not seeds] they vegetate and grow on the branches” (Bartram 1791). The illustration *Map of the Coast of East Florida* by Bartram (1791) depicts an Agavaceae-like plant

which more resembles the paniculate inflorescence of *Furcraea* Vent. than the umbellate flower clusters of *Agave* subg. *Agave* (Fig. 8). Dodge (1893) also mentioned this species (pp. 16, 38) as occurring on the mainland “at Jupiter, at Lake Worth . . . the Perrine Grant, but I do not recall a specimen on any of the Keys.” All of these places were sites of *A. sisalana* cultivation as well (Dodge 1893).

I am unaware of any putatively native populations of *Agave weberi* (= *A. neglecta*) in Florida. All herbarium specimens of *A. weberi* appear to have come from cultivation or disturbed coastal areas. Indeed, the lectotype of *A. neglecta* is based on a cultivated specimen which, though never cited by Small, was presumably available to him. With the exception of Gentry’s determinations, only the isoelectotype at NY was identified as *A. neglecta*. The lectotype (MO) and other isoelectotype (ASU), though having the same collector, date, and specimen morphology, were labeled as *A. sp.* or *A. rigida* var. *sisalana*. Another specimen from Ankona, Florida dated 19 Apr 1895 (McCarty s.n. (MO)) retains an old handwritten determination as *A. neglecta* and so does a plate drawing from a “leaf sent by Kirk Monroe from Cocoanut [Coconut] Grove, Florida” (MO).

Gentry (1982) allied *Agave weberi* with *A. sisalana*, but these species differ in many respects. Dodge (1893) noted this species (p. 38) to be allied with *A. americana*, with which it seems to share more characters. Caution should be exerted when working with *A. weberi* in Florida as exposure to internal leaf tissue caused severe dermal itching and pustulation to myself.

Specimens examined: **Charlotte Co.:** *A.R. Franck* 2648 (USF). **Lee Co.:** *B.F. Hansen & J. Hansen* 6130 (USF). **Palm Beach Co.:** *S.W. Woodmansee & T. Couillard* 619 (FTG, USF). **St. Lucie Co.:** *J. Beckner* 1986 (FLAS). **Sarasota Co.:** *A.R. Franck* 1864, 2260 (FLAS, USF). **Cultivated, Alachua Co.:** *S.B. Davis* 1293, 1633, 1634, 1638 (FLAS). **Cultivated, Miami-Dade Co.:** *K. Monroe s.n.* (MO). **Cultivated, St. Lucie Co.:** *C.J. McCarty* s.n. (MO).

**CINNAMOMUM** Schaeff., Bot. Exped. 74. 1760. TYPE: *Cinnamomum zeylanicum* Blume. Fig. 9.

*Cinnamomum* comprises ~250 species with its center of diversity lying in the Asia-Pacific region (Ravindran et al. 2004; Li et al. 2008). Several species are aromatic and used in food and medicine. The main source of cinnamon in the USA is *C. burmannii* from Indonesia with another alternative source being *C. cassia* (L.) D. Don from China and Vietnam (Ravindran et al. 2004). In contrast with the commercial market of the USA, much of the world distinguishes between different types of cinnamon; for example *C. verum* J. Presl is characterized by different flavors and a higher price (Ravindran et al. 2004).

#### KEY TO CINNAMOMUM IN FLORIDA

1. Buds scaly; leaves pinninerved, often glaucous, with abaxial glands in the basal leaf axils  
 ..... ***Cinnamomum camphora***
1. Buds naked or scales indistinct; leaves trinerved (3 nerves arising from base) or triplinerved (lateral nerves arising from midvein above the base), not glaucous, without abaxial glands.
  2. Leaves triplinerved, lateral veins conspicuous only on basal half of leaf, evanescent near leaf apex  
 ..... ***Cinnamomum burmannii***
  2. Leaves trinerved, lateral veins extending to leaf tip, conspicuous at leaf apex  
 ..... ***Cinnamomum iners***



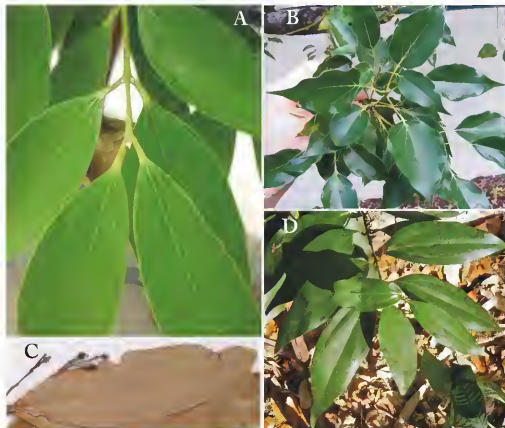


Figure 9. *Cinnamomum*. A – *C. iners*, Putrajaya, Malaysia (photo and permission by Mohd Yusoff), B – *C. camphorum*, Sarasota Co., Florida, C – *C. iners*, St. Lucie Co., Florida (Mejeur & Park s n), D – *C. burmannii*, Sarasota Co., Florida (Franck 2973)

*Cinnamomum burmannii* (Nees & T. Nees) Blume, Bijdr. Fl. Ned. Ind. 11: 569. 1826. *Laurus burmannii* Nees & T. Nees, Cinnam. Disp., fasc. 1: 57. 1823. **LECTOTYPE** (designated by Wu-Kuang 2011): **West Java**. *C. Blume s.n.* (L., isotype, L.).

This is the most common species of cinnamon spice in the USA (Ravindran et al. 2004). Two sterile shrubs were found in a hydric hammock edge in a county park (Fig. 9). No cultivated specimens were located nearby.

Specimens examined: **Sarasota Co.**: A.R. Franck 2973 (USF)

*Cinnamomum camphora* (L.) J. Presl, Prir. Rostlin 2: 47. 1825. *Laurus camphora* L., Sp. Pl. 1: 369. 1753. *Persea camphora* (L.) Spreng., Syst. Veg. 2: 268. 1825. *Camphorna camphora* (L.) Farw., Druggists' Circular 62: 535. 1918. **LECTOTYPE** (designated by Kostermans 1978). *Herb. Linnaeus*, 518.7 (LINN).

*Cinnamomum camphora* is said to have arrived in Florida between 1870–75 (Hood and True 1911). It is more common in the northern part of the state, in some cases dominating secondary forests (Clewell & Tobe 2011). This species is a natural source of camphor, a chemical which also can be synthesized (Ritter 1933).

Specimens examined: **Alachua Co.:** *S.F. Brockington* 491 (FLAS), *C. Easley* 170 (FLAS), *S. Malone* 35 (FLAS), *C. Kabat & S. Kabat* 373 (FLAS). **Brevard Co.:** *A.G. Shuey* M0281 (USF). **Calhoun Co.:** *T. MacClendon & K. MacClendon* 937 (USF), *L.C. Anderson* 21532 (FSU). **Citrus Co.:** *C. vanHoek* s.n. (USF), *R.A. Hattaway* FC0064, FC0109 (USF), *J. Scanlon* 48 (FLAS). **Clay Co.:** *J.A. Ferguson* 55 (FLAS). **Columbia Co.:** *B. Tan* 256 (FLAS). **DeSoto Co.:** *A.G. Shuey* 2125 (FLAS, USF), *R.P. Wunderlin et al.* 6343 (USF), *A.R. Franck* 955 (USF). **Duval Co.:** *R.K. Godfrey* 80941 (FSU). **Escambia Co.:** *G. Wilhelm* 9440 (USF). **Franklin Co.:** *L.C. Anderson* 5469, 6676, 6825, 10566 (FSU). **Gilchrist Co.:** *D.S. Correll & H.B. Correll* 51687 (FTG, USF). **Hernando Co.:** *G.R. Cooley et al.* 6319 (USF), *D.M. Krofta* s.n. (USF), *L.M. Baltzell* 10134 (FLAS). **Highlands Co.:** *S.P. Christman & C.V. Iswaran* 1773 (FLAS). **Hillsborough Co.:** *S. Landry & C. Vandaveer* s.n. (USF), *D. Laker* s.n. (USF), *O.K. Lakela* 32159 (FTG, USF), *O.K. Lakela & F. Almeda* 31342 (USF), *J. Myers* 709 (USF), *S. Mortellaro & W.J. Giesy* 179 (USF), *A.N. Arcuri* 711 (USF). **Lake Co.:** *R.P. Wunderlin et al.* 6645 (USF), *B.F. Hansen et al.* 6493 (FTG, USF). **Lee Co.:** *R. Workman* s.n. (USF), *R. Clark* s.n. (USF), *W.M. Buswell* s.n. (FTG). **Leon Co.:** *K.E. Blum* 2712 (USF), *D.L. Fichtner* s.n. (FSU), *R.K. Godfrey* 60691 (FSU), *R.K. Godfrey* 79567 (FSU, FTG), *L.C. Anderson* 25406 (FSU). **Liberty Co.:** *R.K. Godfrey* 79915 (FLAS, FSU, FTG), *S. McDaniel* 9012 (FSU), *W. Hess et al.* 8482 (FLAS). **Manatee Co.:** *P. Benshoff* LM0079 (USF). **Marion Co.:** *A.B. Meyer & A. Townesmith* (USF), *L.M. Baltzell* 5668 (FLAS). **Osceola Co.:** *S. Myers* 210 (USF). **Orange Co.:** *S. Myers* 53 (USF). **Pasco Co.:** *B.F. Hansen & J. Hansen* 9947 (FSU, USF), *E.M. Ferguson et al.* 734 (USF). **Pinellas Co.:** *B.F. Hansen* 12642 (USF), *G. Fleming* 3471, 3845 (USF), *G.R. Cooley* 979 (USF), *P. Genelle & G. Fleming* 2530 (USF), *B.F. Hansen et al.* 12308 (USF). **Polk Co.:** *P. Genelle & G. Fleming* 2650 (USF), *J.M. Kunzer* 2728 (USF). **Putnam Co.:** *S. Myers* 335 (USF), *B. Herring & G. Schultz* 1595 (FLAS), *A.M. Laessle* s.n. (FLAS). **Santa Rosa Co.:** *G. Wilhelm* 9131 (USF). **Sarasota Co.:** *A.E. Perkins* s.n. (USF). **Seminole Co.:** *W.D. Longbottom & D.H. Williams* 14451 (USF), *D.H. Williams* 2731 (USF). **Sumter Co.:** *R.P. Wunderlin et al.* 9809 (USF), *A. Bishop & K. Alvarez* DB0062 (USF). **Taylor Co.:** *W.S. Judd et al.* 3327 (FLAS, FSU). **Volusia Co.:** *J.M. Kunzer* 1323 (USF), *D. Profant* 73 (FLAS). **Wakulla Co.:** *L.C. Anderson* 23995, 24446 (FSU). **Walton Co.:** *G. Wilhelm* 8090 (USF).

*Cinnamomum iners* Reinw. ex Blume, Bijdr. Fl. Ned. Ind. 570. 1825. TYPE: Java. Reinwardt s.n. (holotype: L; isotype: S).

*Cinnamomum iners* is a popular landscape tree in the Asia-Pacific region (Wuu-Kuang 2011). The naturalized occurrence in Florida was found on a site called Cloud Grove which had been used by the Coca-Cola Company (Calvert 1969; Bridges & Youtsey 1972; Gould et al. 1987; Pelosi et al. 1987). *Cinnamomum iners* may have been cultivated as a cola flavoring ingredient as some cola flavoring recipes have included *Cinnamomum* (Merory 1968; Pendergast 1993; Glass 2011). The principal volatile component of *C. iners*, linalool (Phudthawong et al. 2007), has been detected as an odorant in commercial brands of cola beverages (Lorjaroenphon 2012).

Specimens examined: **St. Lucie Co.:** *R. Mejeur & S. Park* s.n. (FLAS, USF), *Peterman* s.n. (USF).

**CORYMBIA** K.D. Hill & L.A.S. Johnson, *Telopea* 6: 214. 1995. TYPE *Corymbia gummifera* (Gaertn.) K.D. Hill & L.A.S. Johnson. Figure 10.

*Corymbia* has recently been segregated from *Eucalyptus* as a distinct genus (Hill & Johnson 1995, Grattapaglia et al. 2012). *Corymbia* and *Angophora* Cav. appear to share the synapomorphy of bristle glands with four cap cells and micropapillae (Wilson et al. 2001). One species of *Corymbia* has been recorded as naturalized in Florida.

*Corymbia torelliana* (F. Muell.) K. D. Hill & L. A. S. Johnson, *Telopea* 6: 385. 1995. *Eucalyptus torelliana* F. Muell., *Fragm.* 10: 106. 1877. TYPE AUSTRALIA. Queensland. Trinity Bay, 1877, *Fitzalan s.n.* (holotype. MEL).

*Corymbia torelliana* is a common landscape tree in Florida, partly due to its attractive smooth trunk (Fig. 10). The mature leaves and twigs of this species are hirsute and easily distinguished from the other naturalized species of *Eucalyptus*, which have glabrous mature leaves and twigs.

Specimens examined Lee Co.: JR Abbott 23683 (FLAS), JM Kunzer & M. Hamilton 2272 (USF) Palm Beach Co.: R Miller s.n. (FLAS, USF)

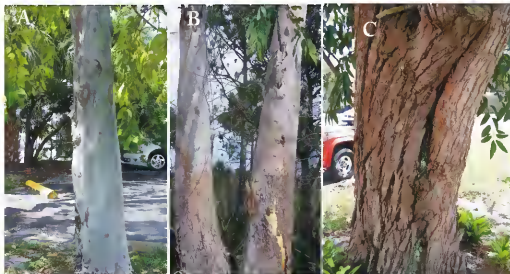


Figure 10. Barks of three eucalypts. A – *Corymbia torelliana*, Sarasota Co., Florida; B – *Eucalyptus camaldulensis* subsp. *acuta*, Charlotte Co., Florida (Franck 1502); C – *Eucalyptus robusta*, Sarasota Co., Florida.

**EUCALYPTUS** L'Hér., *Sert. Angl.* 18: 1789. TYPE *Eucalyptus obliqua* L'Hér. Figure 10

*Eucalyptus* s.s. comprises ~600 spp. (Brooker 2000), most native to Australia. Three species of *Eucalyptus* subg. *Symphyomyrtus* Schauer have been recorded as naturalized in Florida. A few sterile specimens of *Eucalyptus* at FTG collected by Buswell are not included because they cannot here be reliably identified and may be from cultivation. Confidently assigning specimens to species and infraspecific taxa may rely on several characters such as juvenile and adult leaves, bark, flower bud, and fruit.

The earliest record of *Eucalyptus* in Florida is from 1878 on Merritt Island (Zon & Briscoe 1911). The first industrial scale planting is said to have occurred in 1972 (Geary et al. 1983). The eucalypts have been utilized for energywood, mulchwood, phytoremediation, and windbreak in Florida (Rockwood & Peter 1997). Eucalypts are extensively planted in California and 18 species have been recorded as naturalized there (Ritter & Yost 2009).

# KEY TO *EUCALYPTUS* IN FLORIDA

1. Bark rough throughout; length from base of pedicel to fruit rim > 1cm ..... *Eucalyptus robusta*
1. Bark shedding, smooth on upper trunk and branches; length from base of pedicel to fruit rim < 1 cm
2. Fruit hemispheric; peduncle < 2 mm wide ..... *Eucalyptus camaldulensis*
2. Fruit obconic; peduncle > 2 mm wide ..... *Eucalyptus grandis*

*Eucalyptus camaldulensis* Dehnh. subsp. *acuta* Brooker & M. W. McDonald, Austral. Syst. Bot. 22: 270. 2009. TYPE: AUSTRALIA. Queensland. Maranoa River at Forest Vale, ca. 63 km N of Mitchell on road to Injune, 27 Jul 2003, *M.W. McDonald & P.A. Butcher 3182* (holotype: CANB; isotypes: BRI, MEL).

*Eucalyptus camaldulensis* was allegedly the most widely planted eucalypt in Florida (Zon & Bruce 1911, as *E. rostrata* Cav.). Mature flower buds are needed for accurate identification to subspecies (McDonald et al. 2009).

Specimens examined: **Charlotte Co.:** *A.R. Franck 1262, 1502* (FLAS, USF), *A.R. Franck 1345, 1412* (USF).

*Eucalyptus grandis* W. Hill, Cat. Nat. Indust. Prod. Queensland 25. 1862. TYPE: AUSTRALIA. Queensland. Queensland woods, *W. Hill 74* (holotype: K).

*Eucalyptus grandis* is commonly grown in south-central Florida for mulch and it occasionally naturalizes. This species is often confused with and difficult to distinguish from *E. saligna* Sm. (Skolmen 1965; DERM 2006). The authorship and type status follows Bean (2002).

Specimens examined: **Glades Co.:** *B.F. Hansen et al. 11326* (FLAS, USF), *K. Kuhlman s.n.* (USF), *A.R. Franck 1674* (USF). **Hardee Co.:** *M. Scheller s.n.* (FLAS). **Hendry Co.:** *A.R. Franck 1752* (USF), *G. Nelson 1101* (FSU). **Palm Beach Co.:** *R. Miller s.n.* (USF).

*Eucalyptus robusta* Sm., Spec. Bot. New Holland 39. 1795. TYPE: AUSTRALIA. New South Wales. Port Jackson, 1793, *J. White s.n.* (holotype: LINN; isotypes: BM, G, K).

*Eucalyptus robusta* was alleged to be the second-most common eucalypt in Florida in the 1900s (Zon & Briscoe 1911). This species can be quickly separated from other species by its rough bark over the entire trunk (Fig. 10).

Specimens examined: **Brevard Co.:** *B.F. Hansen 12892* (USF), *T. MacClendon et al. 225* (USF). **Charlotte Co.:** *A.R. Franck 2866* (USF). **Lee Co.:** *J.M. Kunzer 2168* (USF). **Martin Co.:** *M. Bodle s.n.* (USF). **Pinellas Co.:** *R. Chicone 686* (USF). **St. Lucie Co.:** *K.A. Bradley et al. 1221* (USF), *C. Lippincott & D. Garvue s.n.* (FTG).

**PANDANUS** Parkinson, J. Voy. South Seas 76. 1773. **TYPE** *Pandanus tectorius* Parkinson

*Pandanus* includes ~600 species native to the paleotropics (Sun & DeFilipps 2010). *Pandanus tectorius* is commonly grown in south Florida as an ornamental.

*Pandanus odorifer* (Forssk.) Kuntze, Revis. Gen. Pl. 2: 737. 1891. *Keura odorifera* Forssk., Fl. Aegypt.-Arab. 172. 1775. **TYPE** not indicated

A sterile specimen of *Pandanus odorifer* was collected in the Florida Keys (Big Pine Key) on a roadside in a marl coastal hammock (Fig. 11). There was no evidence of cultivation or any nearby cultivated specimens. Species of *Pandanus* are dioecious and the collection from the Florida Keys probably only represents a waif occurrence. *Pandanus odorifer* can be recognized by its conspicuous marginal whitish prickles (St. John 1980, Stone 1994, as *P. odoratissimus*).

*Pandanus odorifer* has been regarded as synonymous with the widely used but illegitimate *Pandanus odoratissimus* L.f. (Nicolson et al. 1988, TROPICOS 2012). When Kuntze made the combination for *P. odorifer* the name *P. odoratissimus* was cited in synonymy. The name *Pandanus odoratissimus* L.f. has been in widespread usage (e.g. St. John 1980, Stone 1994), though it appears to be illegitimate because *Athrodactylis spinosa* (Burm.f.) J.R. Forst. & G. Forst. was cited in synonymy, which was superfluous for the earlier valid name *Bromelia sylvestris* Burm.f. The protologue of *Pandanus odoratissimus* L.f. also cites the pre-Linnaean description of *Bromelia sylvestris* Burm.f., which was validly published in 1768.

Specimens examined: **Monroe Co.** - A.R. Franck 2518 (USF).



Figure 11. *Pandanus odorifer*, Monroe Co., Florida (Franck 2518). A – habit; B – shoot; C – white marginal spines.

**SANSEVIERIA** Thunb., Prodr. Pl. Cap. 1: 65. 1794. **TYPE** *Sansevieria thyrsiflora* Thunb. Figure 12.

The genus *Sansevieria* is native to Africa and India and contains ~60 species (Brown 1915). Two species have been recorded as naturalized in Florida. Only on specimens of *S. trifasciata* have I seen fruits in Florida.

# KEY TO *SANSEVIERIA* IN FLORIDA

- 1. Leaf margin orange-red ..... *Sansevieria hyacinthoides*
- 1. Leaf margin green, yellow, or white ..... *Sansevieria trifasciata*



Figure 12 *Sansevieria*. A, C –leaves; B –leaf margin. A, B – *S. hyacinthoides*, Sarasota Co., Florida; C – *S. trifasciata*, Sarasota Co., Florida

*Sansevieria hyacinthoides* (L.) Druce, Bot. Exch. Club Soc. Brit. Isles 3: 423. 1914. *Aloe hyacinthoides* L., Sp. Pl. 1: 321. 1753. *Cordylina hyacinthoides* (L.) W. Wight, Contr. U.S. Natl. Herb. 9: 249. 1904. **LECTOTYPE** (designated by Stearn 1961). **GUINEA**. C. Commelin, Praeludia Bot. 84, t. 33. 1703.

Though *Sansevieria hyacinthoides* appears to spread vegetatively only, it is widespread in central and south peninsular Florida. It can form dense colonies from its thick, bright orange rhizomes. This species was depicted by Dodge in 1893 (as *S. guineensis* (L.) Willd.) as a potential fiber crop and may have been introduced to Florida much earlier than 1893 (Henley 1982). The earliest specimen I have seen from Florida was collected by Britton in 1903 from “waste places” in Key West (NY). I have not seen any herbarium specimens with fruits in Florida.

Specimens examined: **Brevard Co.**: A.G. Shuey & J.E. Poppleton s.n. (USF), O.K. Lakela 28680 (USF), R. Burckhalter 2507 (LSU), L.M. Baltzell 10612 (FLAS), D.B. Ward & R.B. Huck

10701 (FLAS), *B. Herring* & *L. Chafin* 1211 (FLAS). **Broward Co.:** *B.F. Hansen* & *R.P. Saulea* 10365 (USF), *G. Gann* & *K.A. Bradley* 155 (FTG), *B. Schuster s.n.* (FLAS). **Charlotte Co.:** *A.R. Franck* & *B. Upcavage* 1858 (USF). **Collier Co.:** *B.F. Hansen et al.* 11833 (FTG, USF), *O.K. Lakela* 31815 (USF). **Glades Co.:** *A.R. Franck* 1661 (USF). **Highlands Co.:** *D.W. Hall* & *W.S. Judd* 1381 (FLAS, USF). **Hillsborough Co.:** *B.F. Hansen* 12915 (USF). **Indian River Co.:** *J.R. Abbott* & *B.S. Carlsward* 24906 (FLAS), *W.G. D'Arcy* 3012 (FLAS). **Lee Co.:** *S. Todd* 77 (USF), *D.B. Ward* & *S.S. Ward* 2842 (FLAS, FSU, USF), *B.F. Hansen* 4998 (USF), *A.R. Franck* & *S.W. Braem* 2608 (USF), *W.C. Brumbach* 8162 (NY), *J. Beckner* 1753 (FLAS). **Martin Co.:** *D.S. Correll* & *J. Popenoe* 47999 (FTG). **Miami-Dade Co.:** *J.K. Small* & *G.K. Small* 4835 (NY), *R.K. Godfrey* 58095 (FSU). **Monroe Co.:** *A.R. Franck* 2504 (USF), *N.L. Britton s.n.* (NY), *F.C. Craighead s.n.* (FTG), *S.J. Lynch* & *S.A.L. Party s.n.* (FLAS). **Palm Beach Co.:** *P.M. Cassen* 273 (FLAS), *G. Gann* & *K.A. Bradley* 1075 (FTG), *O. Winchester s.n.* (FLAS). **Sarasota Co.:** *B.K. Holst et al.* 6339 (USF), *A.R. Franck* 1745, 1870 (USF). **St. Lucie Co.:** *J. Beckner* 1971 (FLAS).

***Sansevieria trifasciata*** Prain, Bengal Pl. 2: 1054. 1903. TYPE: unknown.

*Sansevieria trifasciata* is an extremely popular ornamental that tolerates low light and low humidity indoors, is drought resistant, and can be easily propagated from leaf cuttings. This species is less frequently naturalized in Florida and does not appear to spread as vigorously as *S. hyacinthoides*.

Specimens examined: **Collier Co.:** *O.K. Lakela* & *D. Laker* 29071 (USF). **DeSoto Co.:** *A.R. Franck* 1734 (USF). **Highlands Co.:** *J.B. McFarlin* 9252 (FLAS). **Hillsborough Co.:** *S.W. Braem* EK0038 (USF). **Lee Co.:** *S.W. Braem* GI0126 (USF). **Martin Co.:** *R.O. Woodbury* & *R. Roberts s.n.* (USF). **Miami-Dade Co.:** *F.C. Craighead s.n.* (USF). **Sarasota Co.:** *A.R. Franck* 1871 (USF).

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**DRESSLERIA MORENOI (ORCHIDACEAE, CATASETINAE):  
A NEW SPECIES FROM COLOMBIA**

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**ABSTRACT**

*Dressleria morenoi* H.G. Hills and M.H. Weber, sp.nov. (Orchidaceae, Catasetinae), is described from the Pacific slope west of Cali, Colombia. Color photographs and comparisons to *D. kalbreyeri*, *D. williamsiana* and *D. kerryae* are provided.

**KEY WORDS:** *Dressleria morenoi*, *Dressleria kalbreyeri*, *Dressleria kerryae*, *Dressleria williamsiana*, Orchidaceae, Catasetinae, Valle de Cauca, Colombia.

The recent taxonomic revision of *Dressleria* (Hills 2012) included a photo of an undescribed species from west of Cali, Colombia. Plants of this species became available due to the effort of Andrea Niessen from Orquideas del Valle, Cali, Colombia. The coauthor supplied the necessary herbarium material and the species can now be named.

***Dressleria morenoi*** H.G. Hills and M.H. Weber, sp. nov. **TYPE: COLOMBIA. Prov. Valle de Cauca.** Rio Digua Valley, old road from Cali to Buenaventura close to Anchicaya, ex. cult. Aug 2012, *M.H. Weber 319/2008* (holotype: K : isotype: K Spirit). Figures 1–4.

*Dressleria morenoi* is most similar to *D. kalbreyeri* (Hills 2000) but differs in the attachment of the lip to the column. In *D. morenoi* the lip is entirely adnate to the column, whereas in *D. kalbreyeri* the lip is adnate to the bottom third of the column. The sepals of *D. morenoi* are closer to the width of the petals than they are in *D. kalbreyeri* with narrow sepals. The low callus mound and the slit-shaped opening to the saccate portion of the lip are essentially the same in both species. *Dressleria morenoi* differs from *D. williamsiana* (Hills 2012) by the lack of the tongue-like callus and a lip entirely adnate to the column. It differs from *D. kerryae* (Hills 2000) by the shape of the opening and by the floral fragrance.

*Dressleria morenoi* fragrance is dominated by methyl salicylate whereas *D. kerryae* fragrance is 1,8-cineole and dimethoxy benzene.

**Pseudobulbs** fusiform to 9 cm tall and 2–3 cm wide. **Leaves** to 45 cm x 15 cm. **Inflorescence** basal, arranged in a loosely flowered raceme, to 45 cm. **Pedicels** to 4.0 cm. **Flowers** nonresupinate, saccate. **Dorsal sepal** 23 mm long and 8 mm wide. **Lateral sepals** 20 mm long and 8 mm wide. **Petals** 18 mm long and 10.5 mm wide. **Lip** entirely adnate to the column, 16 mm long and 11 mm wide, opening to the saccate portion of the lip by a transverse slit to 4.1 mm wide at the base of column, 4.6 mm wide at top, 1.6 mm high. **Column** 6 mm long, 7–8 mm wide at the base.

Known only from the Pacific slope west of Cali, Colombia. The only additional specimen is represented by the photograph (Hills 2012) of a previous collection from the same area made more than 10 years ago.



Figure 1. *Dressleria morenoi*. Photo by Juan Carlos Uribe



Figure 2. *Dressleria morenoi*. Close up of flower; note the wide sepals. Photo by Michael H. Weber



Figure 3. *Dressleria morenoi*. Profile view of the flower showing attachment of the lip to the column. Photo by Michael H. Weber.



Figure 4. *Dressleria morenoi*. Close up of callus mound. Photo by Michael H. Weber.

*Dressleria morenoi* is named for Mario Moreno Marín. Mario was born 24 November 1973 in the town of Bolívar, Valle del Cauca, Colombia. He grew up on the Colombian Pacific coast and went to school with the Chami Indians, where he learned their language. His stepfather, Senen Rendon, was a renowned plant collector and it was from Senen that Mario learned about plants. Mario is an excellent tree climber, knows a lot about the Colombian orchids, and has started his own orchid nursery.

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STUDIES OF NEOTROPICAL COMPOSITAE-VII. *SCHISTOCARPHA*  
*EUPATORIODES* (MILLERIEAE) IN THE DOMINICAN REPUBLIC,  
A NEW GENERIC RECORD FOR THE WEST INDIES

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ABSTRACT

The genus *Schistocarpha* is reported as a new record for the West Indies based on a single collection of *S. eupatorioides* from the Dominican Republic. The species occurs natively in Mexico, Central America, and Andean South America.

**KEY WORDS:** Asteraceae, Compositae, Dominican Republic, Galinsoginae, Hispaniola, Milleriaceae, *Schistocarpha*, West Indies.

*Schistocarpha* Less. (Compositae: Milleriaceae) was revised by Robinson (1979), who recognized 16 Neotropical species. The genus has been treated traditionally in tribe Senecioneae (e.g., Bentham & Hooker 1873; D'Arcy 1975) because of its yellow disk corollas with an elongate tube and capillary pappus bristles. Without comment, Rydberg (1927) removed each *Neurolaena* and *Schistocarpha* from Senecioneae, placing them in the newly described tribe Neurolaeneae. By concave anther appendages, palcate clinanthia, and helianthoid corolla trichomes, Robinson and Brettell (1973) treated *Neurolaena* and *Schistocarpha* in Heliantheae, where Robinson (1979) correctly aligned *Schistocarpha* with subtribe Galinsoginae. More recently, Panero (2007) treated Galinsoginae within tribe Milleriaceae.

The revision of Robinson was used as the basis for further study by Turner (1986), who recognized ten species. More recently, Strother (1999) estimated as four or five the number of species in *Schistocarpha*. Examples of newer synonymy in Turner (1986) include his treatment of *S. longiligula* Rydb. as including four names recognized by Robinson, and Strother (1999) furthered this synonymy by treating *S. longiligula* Rydb. in synonymy of the genotype *S. bicolor* Less. In each Turner (1986), Strother (1999), and Pruski (2010), *S. eupatorioides* is circumscribed as the sole species of *Schistocarpha* with pluriserial pistillate florets having no or at best a much reduced corolla limb. The genus *Schistocarpha* was not reported in the West Indies by Liogier (1962, 1996, 1997), Adams (1972), Robinson (1979, 2006), Turner (1986), Howard (1989), or Strother (1999). As treated here, *Schistocarpha* thus represents a new generic record for the West Indies. The genus ranges from Gulf Coastal northern Mexico through the Isthmus of Tehuantepec, south through the Andes into northern Argentina, and now is known from a single locality in Hispaniola. The generic range mirrors that of *S. eupatorioides*, the most common species in the genus.

We collected *S. eupatorioides* on the north side of the Sierra de Bahoruco in the Dominican Republic, the same locality as Ortiz & Pruski 354 (JBSD, MO) cited by Ortiz (2012) as *Disciphania domingensis* Urb. (Menispermaceae). The plant from the Dominican Republic keys consistently to *S. eupatorioides* in each Robinson (1979, 2006), Turner (1986), and Strother (1999). The purpose of this note is to document *S. eupatorioides* as a genus and species new to the West Indies and to provide generic and specific descriptions of it that may be inserted into the Compositae treatment in the Flora of Hispaniola by Liogier (1996). The present treatment is adapted from those of Fenzl (1849), Robinson (1979, 2006), Turner (1986), Strother (1999), and Pruski (2010).





Figure 1. Voucher of *Schistocarpha eupatorioides* from the Dominican Republic (Pruski & Ortiz 4060, MO).

**SCHISTOCARPHA** Less., *Linnaea* 6: 409. 1831. TYPE: *Schistocarpha bicolor* Less.  
*Neilreichia* Fenzl, *Zycaona* Kuntze

Coarse perennial herbs to shrubs to 5 m tall; stems ascending to scandent, few-branched, subterete, striate, leafy, internodes often elongate; herbage infrequently stipitate-glandular. Leaves opposite or distal ones infrequently alternate, subsessile to long-petiolate; blade lanceolate-deltate to ovate, chartaceous, thinly 3-nerved from near base, surfaces typically without glandular dots, adaxial surface scabrid or sometimes glabrous, abaxial surface glabrous to velutinous or pilosulose, base cuneate to truncate, but usually with acumen decurrent onto petiole, sometimes amplexicaul, margins serrulate to serrate, apex acute to attenuate; petiole typically somewhat winged from decurrent blade. Capitulescence terminal or axillary from the distal nodes, pluricapitate, corymbiform-paniculate; peduncles slender, typically pubescent, sometimes stipitate-glandular. Capitula 6–13 mm long, 13–145-flowered, radiate (usually heterochromous) or indistinctly subradiate, sometimes disciform; involucre cylindrical-campanulate to campanulate; phyllaries 16–40, imbricate, graduated, 3–5-seriate, usually appressed, scarious-chartaceous, usually (3–)7–11-striate, striations drying dark; clinanthium (receptacle or phoranthium) convex to conical, paleate; paleae shorter than disk florets, lanceolate to elliptic-lanceolate, scarious-stramineous, weakly navicular, striate, usually lacerate or trifid. Ray florets (0–)8–25(–60), pistillate, 1(–3)-seriate; corolla typically white, tube about as long as pappus, limb ovate to oblong, short- to well-exserted, nerves equally-thin, lacking larger support veins, apex 3-denticulate. Marginal florets (when capitula obscurely subradiate or disciform), 40–70, 2–4-seriate, pistillate; corolla tubular-filiform and typically obscurely radiate with no or a minute flattened limb. Disk florets 5–75, fewer to more than pistillate florets, bisexual; corolla funnelliform, shortly 5-lobed, yellowish, often pubescent, tube slender, generally about as long as limb, lobes triangular, erect, shorter than throat; anthers cream-colored or greenish to brownish, thecae ecaudate, bases short-sagittate, apical appendage ovate-concave, eglandular; style base dilated, partly immersed in nectary, branches short, partly exserted, with a 2-banded stigmatic surface, apically short-acute, papillose. Cypselae isomorphic, prismatic-obovoid to terete, black, glabrous, carpodium asymmetric, stramineous; pappus of 25–35 elongate subequal white somewhat fragile capillary bristles in a single series.  $x = 8$ . About 10–12 spp. Mexico to South America, and now a single species in the West Indies.

**SCHISTOCARPHA EUPATORIOIDES** (Fenzl) Kuntze, *Revis. Gen. Pl.* 3(3): 170. 1898. *Neilreichia eupatorioides* Fenzl, *Nov. Gen. Sp. Pl.* 6, t. 1. 1849. TYPE: PERU. 'Subandina prope Cuchero' [Huánuco. Near Cuchero, ca. 4–8 km SW of the boca del Río Chinchao at the Río Huallaga, 9° 30–31' S, 75° 56–59' W, ca. 800–1000 m, 1829–1830], *Poeppig Addendis* 74 (holotype: W). The Ruiz & Pavón and Poeppig locality of 'Cuchero' was abandoned and Poeppig said some decayed huts are the only remains of it. Ruiz (1940) said Cuchero [in July 1780] is situated "in a small plain on a hill surrounded on all sides by other higher and rough hills" and Stephens and Traylor (1983) gave it as along the Río Chinchao. Ruiz (1940) gave Cuchero as 26 leagues NE from Huánuco (in the direction of Chinchao, league 18) and from Cuchero only "two short leagues downhill to the Huánuco river" [i.e., Río Huallaga] near the mouth of the Río Chinchao. The distance on modern maps from Huánuco to the mouth of the Río Chinchao at the Río Huallaga is about 55 kms, placing Cuchero near modern day San Juan and about 4–8 km SW of the boca del Río Chinchao at the Río Huallaga. Figures 1–2.

*Schistocarpha hoffmannii* Kuntze, ?*Schistocarpha margaritensis* Cuatrec., *Schistocarpha oppositifolia* (Kuntze) Rydb., *Zycaona oppositifolia* Kuntze

Perennial herbs to subshrub 0.5–3 m tall; stems pubescent to less commonly glabrate. Leaves petiolate; blade 4–20 × (0.5–)2.5–13(–17) cm, ovate or distal ones lanceolate, surfaces rarely finely gland-dotted, adaxial surface strigillose to sometimes glabrous, abaxial surface pilosulose to strigose, much less commonly glabrous, base obtuse to subcordate or truncate, then abruptly attenuate



Figure 2. *Schistocarpa eupatorioides*. Close-up of capitula at anthesis showing the 3–4-seriate tubular-filiform pistillate florets with corolla limbs reduced or absent. The scale bar at top has increments of 1 cm (Pruski & Ortiz 4060, MO)

onto petiole, basal acumen to 3 cm long, apex acuminate to attenuate, petiole 0.8–7 cm long. **Capitulescence** usually  $2\text{--}15 \times 2\text{--}15$  cm, each branchlet 20–50+ capitulate with 1–3 clusters, clusters usually moderately dense-spherical and cymose, infrequently nearly flat-topped and corymbiform, peduncles 2–10(–30) mm long, pubescent to pilose, occasionally also stipitate-glandular, often 1-bracteolate, bracteole 2–4 mm long, linear-lanceolate, typically basal. **Capitula** 7–9 mm tall, 35–88-flowered, indistinctly subradiate to disciform, involucre 4–7 mm diam; phyllaries 25–30, 1.5–8 mm long, elliptic-lanceolate grading to lanceolate, 3–4-seriate, glabrous or sometimes sparsely ciliate distally, apex commonly obtuse to rounded, paleae 5–6 mm long, linear-lanceolate, usually persistent, stramineous, apically lacerate, central part sometimes long-attenuate. **Marginal florets** 30–70, indistinctly subradiate or tubular-filiform (often within a single capitulum), 3–4-seriate, corolla white to yellowish, tube 4–5 mm long, laxly pilosulose, limb 0–1 mm long, when present ca.  $5\times$  shorter than tube, sometimes faintly 3-nerved, style sometimes much longer than corolla. **Disk florets** 5–18, corolla 4.5–5.5 mm long, yellowish, tube 2–3 mm long, glabrous (in Hispaniola and often in Central American populations) or sparsely setose (often in South American populations), throat ca. 2 mm

long, glabrous, lobes ca. 0.5 mm long, commonly setulose; anthers partly exserted; style branches to ca. 0.5 mm long. Cypselae 1–1.5 mm long; pappus bristles ca. 4.5 mm long.  $2n = 16$ .

**Distribution and ecology.** *Schistocarpha eupatorioides* is reported here as new for the West Indies from a single locality in the Dominican Republic on the island of Hispaniola. It otherwise occurs from Gulf Coastal northern México, throughout much of Central America, into Colombia and Venezuela, and thence south in the Andes through Ecuador, Peru, Bolivia, and ultimately into northern Argentina. Because Turner (1986) gives *Schistocarpha margaritensis* Cuatrec. as a possible hybrid, it is listed here only as a possible synonym. *Schistocarpha eupatorioides* flowers throughout most of the year (less so in April and May) and occurs mostly in disturbed, moist, or open areas below 1800 meters elevation. In the Dominican Republic, *S. eupatorioides* was seen at the single mid-elevational sunny roadside locality cited below. The Hispaniolan material has glabrous disk corolla tubes as do most populations from Mexico and Central America. However, South American plants may exhibit similar morphology, thus the possible source of plants introduced into Hispaniola cannot be identified on the basis of this feature.

**Voucher.** DOMINICAN REPUBLIC. Barahona. Sierra de Bahoruco (northern side), entrada of Polo along DR Carretera Ramal 533, ca. 20 km S (uphill) of Cabral, 18°06'42"N, 71°16'18"W, 822 m, 27 Jun 2006, Pruski & Ortiz 4060 (JBSD, MO, NY, S, US).

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A NEW SPECIES OF *MARSHALLIA* (ASTERACEAE, HELENIEAE, MARSHALLIINAE)  
FROM MAFIC WOODLANDS AND BARRENS  
OF NORTH CAROLINA AND VIRGINIA

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ABSTRACT

A new species of *Marshallia* (Asteraceae, Helenieae, Marshalliinae) is proposed and contrasted with the morphologically most similar and putatively most closely related species, *M. grandiflora* and *M. obovata*. The new species is known from a few sites in the Piedmont of north-central North Carolina and south-central Virginia, occurring solely or primarily in remnants of fire- and edaphically maintained oak savannas, barrens, and “prairies” developed over cation-rich, shrink-swell clay soils derived from the mafic rocks diabase and greenstone.

**KEY WORDS:** *Marshallia legrandii*, *Marshallia obovata*, *Marshallia grandiflora*, Asteraceae, Helenieae, North Carolina, Virginia, Georgia, Florida, southeastern United States, endemic, imperiled

*Marshallia* Schreber is a small genus (7–11 taxa) endemic to the southeastern USA (interpreted broadly), with species extending as far north as southwestern Pennsylvania and as far west as southeastern Kansas, central Oklahoma, and central Texas. It has long been regarded as distinctive, enigmatic, and “strange” (Baldwin 2009), with contrasting assessments of its closest generic relatives and tribal placement. Beadle & Boynton (1901) published the first comprehensive account of the genus and established the foundation for an understanding of its component species, naming three species (each of them rare and local: *M. grandiflora* Beadle & Boynton, *M. mohrii* Beadle & Boynton, and *M. ramosa* Beadle & Boynton) and recognizing a total of 11 taxa (7 species, with 4 additional varieties). Building on this, Channell (1957) monographed the genus, largely agreeing taxonomically with Beadle & Boynton (1901), recognizing 10 taxa (8 species, with 2 additional varieties), by elevating one of Beadle & Boynton’s (1901) varieties to specific rank (*M. tenuifolia*) and dismissing another (*M. graminifolia* var. *laciniatoides*). In the half-century since Channell (1957), the most notable work on the genus has been by Linda Watson, James Estes, and collaborators, who published a series of publications in the early 1990s exploring the taxonomy of members of the genus and its tribal affinities (Watson & Estes 1990; Watson, Elisens, & Estes 1991; Watson, Jansen, & Estes 1991).

Recent floristic works have generally followed the framework established by Channell (1957), with minor but significant diversity of opinion about the worth of recognition of some varieties or their taxonomic rank. Cronquist (1980) followed Channell exactly (8 species, 2 additional varieties). In her *Flora of North America* treatment, Watson (2006) formally recognized 7 species, providing characters and distributions for three additional varieties, apparently considered them of uncertain or optional taxonomic value. A consensus list of taxa accepted in the genus in the early 21<sup>st</sup> century would include these: *M. caespitosa* Nutt. ex DC. var. *caespitosa*, *M. caespitosa* Nutt. ex DC. var. *signata* Beadle & Boynton, *M. graminifolia* (Walt.) Small, *M. tenuifolia* Raf., *M. grandiflora* Beadle & Boynton, *M. mohrii* Beadle & Boynton, *M. obovata* (Walt.) Beadle & Boynton var. *obovata*, *M. obovata* (Walt.) Beadle & Boynton var. *scaposa* Channell, *M. ramosa* Beadle & Boynton, and *M. trinervia* (Walt.) Trel.

In 1986, North Carolina Natural Heritage Program biologist Harry E. LeGrand, Jr. found an unusual population of *Marshallia* near Butner, Granville County, North Carolina. This *Marshallia* was found in a dry, mafic barren over diabase in a site since dubbed the Picture Creek Diabase Barren (North Carolina Natural Heritage Program). LeGrand tentatively identified the Picture Creek *Marshallia* using existing floristic treatments (Radford, Ahles, & Bell 1968; Cronquist 1980) as *M. grandiflora* Beadle & Boynton, but noted that the identification was not definite or satisfying (North Carolina Natural Heritage Program 1986). The mention in Radford, Ahles, & Bell (1968) of *M. grandiflora* as occurring in Granville County made this new record seem plausible, though the habitat given ("bogs") was less felicitous. A review of specimens at the University of North Carolina Herbarium (NCU) by the first author revealed the specimen on which this record was based (NCU 225014: Granville County: Bog, 1.5 mi E of Hester, A.E. Radford 43945, 16 Jun 1961), and that this specimen matched the material found by LeGrand at Butner and differed morphologically from *M. grandiflora* in the same ways. Attempts by the first author in the late 1980s and early 1990s to relocate the Picture Creek population were unsuccessful.

In 1971 and again in 1980, A.M. and B.J. Harvill collected what they considered to be *Marshallia obovata* slightly to the north of the Picture Creek locality in Halifax County of south-central Virginia (collections cited below). One of the sites where the *Marshallia* was collected, Difficult Creek, became a land conservation project by the Virginia Department of Conservation, and the populations of the state rare "*M. obovata*" came under greater scrutiny from biologists of the Virginia Division of Natural Heritage, who found that populations of both *M. obovata* and the putative new species from Picture Creek were present, morphologically distinguishable and phenologically offset from one another (Figure 1). In both North Carolina and Virginia, the undescribed taxon has been informally accepted as a species warranting conservation tracking and monitoring (Buchanan & Finnegan 2010; Townsend 2009).

**Taxonomy.** With four known populations (of which two are known to be extant, and two historical and possibly extirpated), this morphologically distinctive entity, associated with a distinctive habitat, phenologically separated from sympatric and syntopic populations of its congener *M. obovata*, highly impaired by its rarity and the need for fire management of its habitat, warrants taxonomic recognition.

***Marshallia legrandii* Weakley, sp. nov.** (Figure 2). USA. North Carolina. Granville Co.: Picture Creek Diabase Barren, N of Butner, 22 Jul 2003, A.S. Weakley 7274 with L.M. Giencke and J.P. Perry III (holotype: NCU; isotypes: AUA, MO, NCSC, NCU, NY, US).

Paratypes: USA. North Carolina. Granville Co.: Bog, 1.5 mi E of Hester, Radford 43945, 16 Jun 1961 (NCU 225014). Virginia. Halifax Co.: Oak-pine woods 1 mi S of Difficult Creek on Rt. 719, 25 Jun 1972, Harvill 25539 (FARM [2 sheets], VPI 85782); border of dry, cut-over oak-hickory woods over basic rock, along SE side of Rt. 719, 1.1 mi SW of bridge over Difficult Creek, 3.3 mi E of Scottsburg, elev. 490 ft, common, 1 Jun 1995, Fleming 10448 (VPI 90521); Difficult Creek Heritage Preserve, mafic flats E of County Road 719, habitat mafic woodlands, 27 Jun 2003, Weakley 7255 (NCU 568186, NCU 569188); roadside 3 mi E of Halifax, 9 Jun 1980, Harvill 41178 (LYN 42010). Known stations for the species are shown in Figure 3.

**Perennial**, 60–80(–100) cm, fibrous-rooted, from caudices, and forming basal offsets. **Stems** erect, unbranched, striate, especially immediately below the head. **Leaves** basal and cauline, alternate; the first basal (most proximal) leaves often withering by anthesis, 1/3–1/2 as long as the next most proximal and longest basal and low cauline leaves, these longest leaves 15–25(–32) cm long (including the long petiole-like basal taper) and 7–20 mm wide, the apex acute to acuminate (rarely narrowly obtuse), the longest leaf on a plant (usually low cauline) 15–30 cm long, the leaves

gradually reduced upwards, extending 2/3 to 4/5 of the length of the stem; well-developed blades prominently 3-nerved, lanceolate to oblanceolate (sometimes linear-oblanceolate). Heads strictly single. Involucres hemispheric to obconic, 20–25 mm in diameter (as measured phyllary tip to phyllary tip). Phyllaries 8–11 mm long, the broadest (outermost) phyllaries 2.5–3.7 mm wide, grading into narrower phyllaries inwards (and eventually into paleae), the apices acute to broadly acute, the distal surface densely glandular with both impressed glands and raised resin dots (Figure 4). Paleae acute-acuminate and only gradually and slightly dilated towards the apex, the distal surface glandular with both impressed glands and raised resin dots. Corollas pale to deep pink (Figure 5), lobes 5–7.5 × 0.7–1.1 mm. Cypselae mostly 3.0–3.2 mm long × mostly 1.5–1.6 mm wide (near the apex) and 0.8 mm wide (near the base), strigose, 5-angled, 10-ribbed. Pappus scales 1.1–1.3 mm long, scarious or hyaline, glabrous to scabrous on the distal surfaces, the margins entire to scabridulous.

*Marshallia legrandii* is readily distinguished from most members of the genus by the following features. Plants strictly single-headed (separating it from *M. graminifolia*, *M. tenuifolia*, *M. ramosa*, *M. mohritii*, *M. caespitosa* var. *signata*), leaves basally disposed (separating it from *M. trinervia*), stem pubescent at least in the scapose portion below the head(s) (separating it from *M. trinervia*), corollas pale to deep pink (separating it from *M. obovata* var. *obovata*, *M. obovata* var. *scaposa*, *M. ramosa*, *M. caespitosa* var. *caespitosa*, *M. caespitosa* var. *signata*). *M. legrandii* shows closest similarities to *M. obovata* var. *obovata* and *M. grandiflora* but is readily separable from each.

*Marshallia legrandii* differs from *M. obovata* var. *obovata* in its greater stature (usually 6–9 dm tall vs. usually 3–5 dm tall), its larger heads (Figure 4), its corolla color (pale to deep pink vs. white to very pale pink; Figures 4, 5, 6, 7, 8), the greater length of the lower leafy portion of its stem (23–50 cm long vs. 5–30 cm long; Figures 2, 5, 10), its later flowering (June–July vs. April–early June; Figure 1) even when growing at the same site, the shape of its basal and lower cauline leaves (narrowly oblanceolate, mostly 15–25 cm long including the petiole, mostly 7–20 mm wide, averaging about 10–20× as long as wide including the petiole, the apex acute to acuminate, vs. obovate to oblanceolate, mostly 6–10 cm long, mostly 8–14 mm wide, averaging about 6–10× as long as wide, the apex obtuse to rounded and often emarginate; Figures 2, 5, 10), the reduction upwards of the size of the stem leaves (gradually reduced upwards, several of the uppermost leaves <½ as long and as wide as the largest lower stem leaves, vs. the uppermost stem leaves only slightly smaller than the largest lower stem leaves, excepting sometimes 1–2 greatly reduced bracts; Figures 2, 5, 10), the apex shape of the outer phyllaries (acute or acutish vs. obtuse to rounded; Figure 9), the apex shape of the paleae (acute-acuminate and not or gradually dilated towards the apex vs. acute and distinctly and abruptly dilated; Figure “7”), and the glandularity of the outer surface of the phyllaries and paleae (with abundant resin glands vs. with few or no resin glands) (Figures 4, 9).

*Marshallia legrandii* differs from *M. grandiflora* in the size and shape of the basal and lower cauline leaves (mostly 15–25 cm long including the petiole, mostly 7–12 mm wide, averaging about 20× as long as wide including the petiole, the apex acute to acuminate, vs. mostly 3–13 cm long including the petiole, mostly 10–20 mm wide, averaging about 6× as long as wide including the petiole, the apex obtuse to rounded; Figures 2, 5, 11), pappus scale size (ca. 1.2 mm long vs. ca. 2 mm long), plant stature (mostly 6–9 dm tall vs. 3–5 dm tall); achene vestiture (with copious resin-dots between the ridges vs. without resin dots between the ridges; Figure 9), and distribution and habitat (of mafic woodlands and barrens of the Piedmont of southcentral Virginia and northcentral North Carolina, vs. of flood-scoured riverbanks, floodplain forests, and bog margins of the Allegheny and Cumberland Plateaus of southwestern Pennsylvania, West Virginia, eastern Kentucky, and eastern Tennessee, rarely east to the Blue Ridge of southwestern North Carolina; Figure 3).





Figure 1 Phenological contrast of *Marshallia obovata* var. *obovata* and *M. legrandii*, Difficult Creek, 16 June 2009; photos by Irv Wilson. A. *Marshallia obovata* var. *obovata*, in early to middle fruiting B. *Marshallia legrandii*, in mid-flower (outer flowers withering, inner flowers not yet open)



Figure 2. Holotype of *Marshallia legrandi* Weakley.

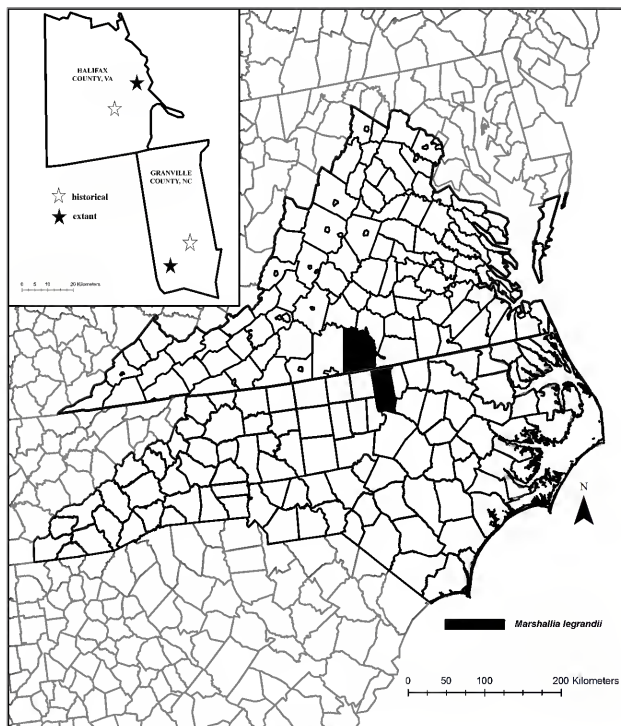


Figure 3. Documented distribution of *Marshallia legrandii*.

**Etymology.** The first author chooses to name this species for his colleague Harry E. LeGrand, Jr., for three reasons.

1) LeGrand first found and recognized the unusual morphology and importance of the population at the Picture Creek Diabase Barren, leading ultimately to this re-evaluation. Although the species had been collected thrice before (by Radford in 1961 and by Harvill & Harvill in 1972 and 1980), it is quite likely that its distinctive features would have gone unnoticed without LeGrand's careful observations from the fourth and by far the largest population known to date.

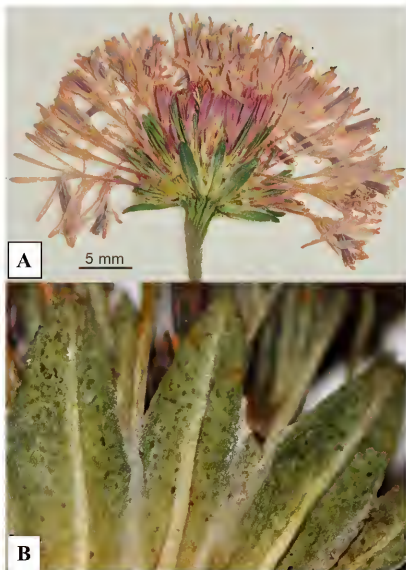


Figure 4. A. Flowering head of *Marshallia legrandii*. Head is 4.3 cm wide, from flower tip to flower tip. Paratype from Difficult Creek. B. Closeup of phyllaries of *Marshallia legrandii*, showing strongly glandular distal surface. Holotype.



Figure 5. Flowering specimen of *Marshallia legrandii*. Paratype, from Difficult Creek



Figure 6. Head of *Marshallia legrandii* from below, showing phyllaries (shape and glandularity) and medium pink corollas. Photograph by Curtis Hansen, June 11, 2012, Picture Creek.

2) Over the course of his career with the North Carolina Natural Heritage Program (28 years and counting), LeGrand has had an instrumental role in the discovery and protection of numerous natural areas in North Carolina, especially in the Piedmont. Perhaps none of his discoveries have been more important than the various “diabase natural areas” he discovered and documented in the

course of the Superconducting Supercollider Survey (North Carolina Natural Heritage Program 1986), including the Picture Creek Diabase Barren and the Butner Diabase Glade, from which another new species, *Phemeranthus piedmontanus* S. Ware, was recently named (Ware 2011).

3) *Marshallia legrandii* is indeed “*le grand*” *Marshallia*, taller than *M. obovata*, with which it has been confused, and among the tallest species in the genus



Figure 7 Head of *Marshallia legrandii* from above, showing paleae and medium pink corollas. Photograph by Curtis Hansen, June 11, 2012, Picture Creek

**Habitat** The two known extant sites (Picture Creek Diabase Barren and Difficult Creek Natural Heritage Preserve) for *Marshallia legrandii* have notable similarities, in being remnants of mafic woodlands, savannas, or prairies that were once relatively common in the southeastern Piedmont (Noss 2012). Diabase, greenstone, and other mafic rocks in the southeastern Piedmont weather to clay-rich soils with hardpan characteristics, in which extreme fluctuations of soil moisture availability, cracking of soil during dry periods, flat landscapes creating large natural fire compartments, and occasional fires set by lightning and humans maintained “prairie-like” conditions suitable for calciphilic heliophytes. Such sites have been described as “Piedmont prairies” and are of great conservation, ecological, and biogeographic interest, because of their large numbers of narrowly endemic or highly disjunct and regionally rare plant species (Barden 1997, Davis et al 2002, Noss 2012). The habitats present at the third and fourth sites are more difficult to assess because they lack known extant populations of *Marshallia legrandii*; the Hester location is over mafic rocks (diabase),

while Harvill's "3 miles E of Halifax" collection appears not to be based on coarse-scale geologic mapping, but has not been searched for and the locality is rather vague



Figure 8. Habitat aspect of *Marshallia legrandii* at Picture Creek (type locality). Photograph by Curtis Hansen, June 11, 2012

The Picture Creek Diabase Barren features many narrowly endemic and disjunct species tracked as rare by the North Carolina Natural Heritage Program and listed as Threatened or Endangered by the United States Fish and Wildlife Service and the North Carolina Plant Conservation Program (Buchanan & Finnegan 2010). Among the notable species co-occurring with the unusual population of *Marshallia* at the Picture Creek Diabase Barren are *Solidago rigida* var. *glabrata*, *Solidago ptarmicoides*, *Symphyotrichum depauperatum*, *Echinacea laevigata*, *Carex meadii*, *Silphium terebinthinaceum*, *Baptisia australis* var. *aberrans*, *Ruellia humilis*, *Eryngium yuccifolium* var. *yuccifolium* (North Carolina Natural Heritage Program 1986, Buchanan & Finnegan 2010, all nomenclature and taxonomic concepts follow Weakley 2012). This set of species collectively is a mixture of very narrow endemics, broader endemics, and Midwestern disjuncts all associated with the regionally rare (in the Piedmont) combined conditions of 1) circumneutral soils with high base status, 2) frequent fire (at least historically), and open-canopy, sunny conditions.

The Picture Creek community type is classified as the *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - *Echinacea laevigata* - *Oligoneuron album* Woodland or Xeric Hardpan Forest (Northern Prairie Barren Subtype), given a G1 conservation rank, the most highly imperiled ranking possible in the NatureServe conservation ranking system (Schafale 2012, NatureServe 2012, Slapcinsky 1994). Highlighting the unusual edaphic conditions at the site is the classification of the



soil at the site as a narrowly endemic series, the Picture series, a fine, smectitic, thermic Vertic Argiaquoll (Natural Resources Conservation Agency 2012).

Similarly, the Difficult Creek Natural Heritage Preserve supports relict communities determined by montmorillonitic soils derived from mafic and ultramafic rock and the historic occurrence of fires maintaining an open canopy. Though much of the site was altered by conversion to loblolly pine plantations in the 1980s, remnant patches of more natural vegetation remained, and some of the heliophytic species were able to persist in these sites and along roadsides, powerline rights-of-way, and a gas line right-of-way through the area. Now, with the area being restored by selective tree removal and prescribed fires, heliophytic taxa are reoccupying suitable habitats. The vegetation at the site is classified as a *Quercus stellata* - *Carya* (*septentrionalis*, *glabra*) - (*Quercus marilandica*) / *Ulmus alata* / (*Schizachyrium scoparium* - *Piptochaetium avenaceum*) Woodland [= CEG003714] (NatureServe 2012) or one of the Piedmont Hardpan Forest types in the Virginia community classification: *Quercus stellata* - *Quercus alba* - *Carya glabra* / *Ulmus alata* / *Piptochaetium avenaceum* - *Scleria oligantha* Forest (Southern Piedmont Hardpan Forest) (Fleming & Patterson 2012).

Among the unusual and at least regionally rare taxa occurring with or near the *Marshallia* at Difficult Creek are *Echinacea laevigata*, *Eryngium yuccifolium* var. *yuccifolium*, *Marshallia obovata* var. *obovata*, *Gillenia stipulata*, *Cirsium carolinianum*, *Dichanthelium amulmum*, *Anemone berlandieri*, *Lythrum alatum*, *Rhynchospora harveyi*, *Carex meadii*, *Tragia urticifolia*, *Ambrosia bidentata*, *Symphotrichum laeve* var. *concinnum*, and others (G.P. Fleming, pers. comm. 2012; J.C. Ludwig, pers. comm. 2012; J.R. Townsend, pers. comm. 2012).

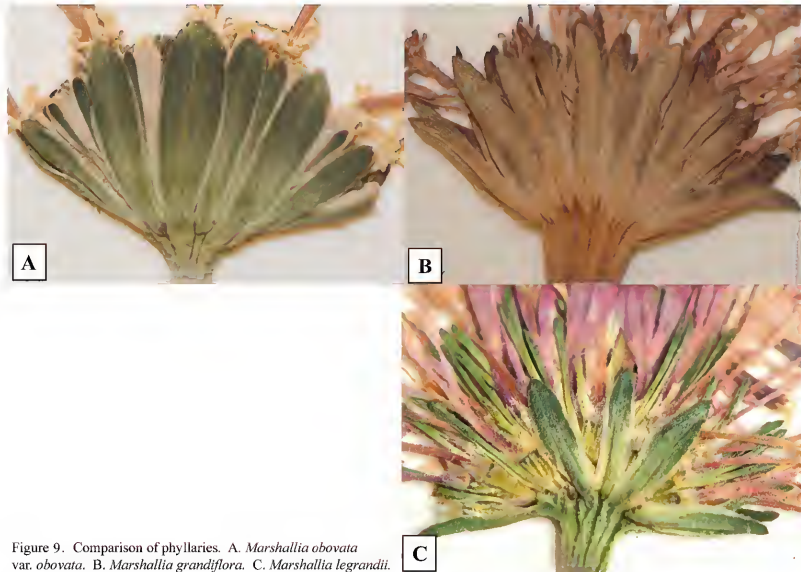


Figure 9. Comparison of phyllaries. A. *Marshallia obovata* var. *obovata*. B. *Marshallia grandiflora*. C. *Marshallia legrandii*.



Figure 10. Representative example of *Marshallia obovata* var. *obovata*.



Figure 11. Representative example of *Marshallia grandiflora*.

**A New Key.** We offer the following key to *Marshallia* with single heads and basally disposed leaves. A comprehensive key to the genus *Marshallia* will be provided in the near future.

1. Leafy portion of the stem 23–50 cm long, the naked peduncle 0.4–1.2× as long as the leafy portion of the stem; stem leaves reduced upward, the uppermost < 1/3 as long and wide as the largest leaves on the plant; basal leaves obovate to oblanceolate, the apex obtuse to acute or acuminate; outer well-developed phyllaries with acute to obtuse apex, the outer surface with abundant resin glands; corollas medium pink; flowering early June–July.
2. Basal and lower cauline leaves (2–)3–13(–20) cm long (including the petiole), (5–)10–20(–30) mm wide, averaging about 6× as long as wide (including the petiole), the apex obtuse to rounded; pappus scales 1.5–2.2 mm long; plants (2–)3–5(–8.5) dm tall; achenes with absent or scattered resin dots between the ridges; Mountains of sw PA, WV, e KY, e TN and sw NC ..... ***Marshallia grandiflora***
2. Basal and lower cauline leaves 15–25(–32) cm long (including the petiole), (3–)7–12(–15) mm wide, averaging about 10× as long as wide (including the petiole), the apex acute to acuminate; pappus scales 1.0–1.3 mm long; plants (4–)6–9(–10) dm tall; achenes with copious resin dots between the ridges; Piedmont of nc NC and se VA ..... ***Marshallia legrandii***
1. Leafy portion of the stem 0–20(–30) cm long, the naked peduncle 1.5–10× (or more) as long as the leafy portion of the stem; stem leaves (if present) not reduced upward, the uppermost > 1/2 as long and wide as the largest leaves on the plant; basal leaves obovate to oblanceolate, the apex obtuse to rounded (often emarginate); outer well-developed phyllaries with obtuse to rounded apex, with or without resin glands; corollas white to very pale pink; flowering late April–May(–early June).
3. Outer phyllaries lanceolate, apices both conspicuously tapered and apiculate; shale barrens, hillsides, and rocky limestone slopes, of se TX, w LA, e OK, se KS, nw AR, and sw MO ..... ***Marshallia caespitosa* var. *caespitosa***
3. Outer phyllaries oblong-obovate, apices conspicuously rounded (though often also apiculate); glades, barrens, roadbanks, and mesic longleaf pine savannas of se VA, NC, SC, GA, AL, and Panhandle FL.
4. Plant with 3–10 leaves on the lower stem, extending (5–)8–20(–30) cm up the stem; pappus scales (0.5–)0.7–1.2(1.5) mm long; plant (2–)3–5(–7) dm tall; outer surface of phyllaries and paleae generally lacking sessile resin glands (occasionally with a few punctate glands); Piedmont and rarely Coastal Plain from se VA southward ... ***Marshallia obovata* var. *obovata***
4. Plant scapose (all of the leaves basal) or nearly scapose, with 1–5 leaves extending 1–5(–10) cm up the stem; pappus scales (1.0–)1.5–2.5(–3.0) mm long; plant (0.5–)1.5–3.5(–5.0) dm tall; outer surface of phyllaries and paleae with many punctate and sessile resin glands; Coastal Plain and rarely outer Piedmont from NC southward ..... ***Marshallia obovata* var. *scaposa***

**Future Studies.** The authors and collaborators plan additional studies to resolve the appropriate taxonomic ranks of taxa in the “*caespitosa*,” “*scaposa*,” and “*graminifolia*” complexes. Curtis Hansen (AUA) has initiated molecular phylogenetic studies that should help resolve relationships in the genus and clarify the roles of allopolyploidy, autopolyploidy, and allopatric differentiation and speciation in the genus.

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## **SOLIDAGO PALLIDA (ASTERACEAE: ASTEREA) NEW TO ONTARIO AND CANADA**

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### **ABSTRACT**

The presence of *Solidago pallida* is reported for the first time in Canada, from northwestern Ontario. The species is known in Canada from a single population in the Lake of the Woods region near Manitoba. Initially thought to be an unusual marginal population collection of *S. speciosa* with hairy fruit, the true identity was confirmed by comparing many collections of the two species with those of *S. jejunifolia* and *S. rigiduscula*. The Canadian collections of *S. pallida* are the northeastern most known population of the species, which is frequent in the Black Hills of South Dakota and occasional in the lower foothills of the Frontal Range of the Rocky Mountains in Wyoming, Colorado, and northern New Mexico. Collections from North Dakota have not yet been seen, but the presence of the species in that state seems likely.

**KEY WORDS:** *Solidago pallida*, *Solidago speciosa*, *Solidago rigiduscula*, *Solidago jejunifolia*, Ontario, Canada, rare plants

A collection of what was thought to possibly be *Solidago speciosa* Nutt. subsp. *speciosa* was made by M.J.O. and W.D.B. on 6 September 2005 from along the Winnipeg River north of Kenora, Kenora District, Ontario, Canada (49.78° N, 94.52° W; Fig. 1). A duplicate of the collection Oldham & Bakowsky 32123 (MICH, NHIC, WAT; Fig. 2) was sent to J.C.S. for confirmation of identification. The specimen had large lower stem leaves like *S. speciosa* but had sparsely hairy fruits. In 2011, L.T. included the WAT duplicate in her Senior Year Honors Project (Biol499), a multivariate morphometric analysis of the *Solidago speciosa* complex. The details of the expanded study on all taxa in *Solidago* subsect. *Squarrosae* was completed in the fall of 2012 and will be reported elsewhere. A significant conclusion of the preliminary study was that *S. speciosa* as treated in Flora of North America (Semple & Cook 2006) should be split into four separate species: *S. speciosa*, *S. jejunifolia* Steele, *S. pallida* (Porter) Rydb., and *S. rigiduscula* (Torr. & A. Gray) Porter. Unexpectedly, Oldham & Bakowsky 32123 (WAT) was placed a posteriori in the multivariate study into the *S. pallida* a priori group with high probability rather than in the *S. speciosa* group. Either placement would have been significant because neither taxon was previously known from Ontario (Semple et al. 1999).

*Solidago pallida* in Ontario grows in an open Bur Oak (*Quercus macrocarpa*) – Jack Pine (*Pinus banksiana*) woodland on a south-facing slope with Porcupine Grass (*Hesperostipa spartea*) and Big Bluestem (*Andropogon gerardii*) in the understory. The site occupied by *S. pallida* has shallow soil interspersed with rocks and is steep, sloping down to Palmerston's Channel of the Winnipeg River. Other common associated species include Pennsylvania Sedge (*Carex pensylvanica*), Poverty Grass (*Danthonia spicata*), Prairie Onion (*Allium stellatum*), and Beard



Figure 1. *Solidago pallida* in the field north of Kenora, Ontario, growing on a *Hesperostipa spartea* dominated slope above the English River.





Figure 2. *Solidago pallida* voucher: Oldham & Bakowsky 32123 (WAT).

tongue (*Penstemon gracilis*). Less abundant associated species include Tickle Grass (*Agrostis scabra*), Bastard Toadflax (*Commandra umbellata*), Rusty Woodsia (*Woodsia ilvensis*), vetch (*Vicia* sp.), and Thyme-leaved Spurge (*Chamaesyce serpyllifolia*). On 15 September 2009 the population was surveyed by M.J.O. and Jane M. Bowles, resulting in a count (with the occasional estimate of plants in larger patches) of 830 vegetative plants and 280 flowering plants totalling ~1110 mature individuals. The population is not near a road or any human habitations and introduced species are rare at the site. There is no evidence to suggest the population is not native.

*Solidago rigidnucula* has been reported from Ontario under the synonym *S. spectosa* var. *rigidnucula* Torr. & A. Gray (Semple et al. 1999; Committee on the Status of Species at Risk in Ontario 2011). It occurs on Walpole Island in southwestern Ontario some 1200 km from the Kenora District site. *Solidago rigidnucula* loses its lower stem leaves by the time shoots flower. Rosette leaves and basal stem leaves are similar to those of *S. speciosa*. Basal rosette and stem leaves of *S. jejunifolia* have long narrow petioles and persist into flowering. Rosette leaves and lower stem leaves of *S. pallida* are petiolate but with more tapering winged petioles like those of *S. speciosa* and *S. rigidnucula*.

Specimens of *S. pallida* are more likely to be confused with specimens of *S. jejunifolia* and *S. rigidnucula* than with specimens of *S. speciosa*, at least in terms of upper leaf and floral traits. *Solidago speciosa* is an east-of-the-Appalachian-Mountains species whose range is extended from the Appalachians to the eastern edge of the Great Plains by tetraploids. The other three species are diploids found in the Great Lakes area and in prairie and savannah habits as far west of the Rocky Mountains. *Solidago pallida* is the westernmost of the three species. *Solidago jejunifolia* is restricted to northern Michigan, Wisconsin, and northern and eastern Minnesota and possibly adjacent areas. *Solidago rigidnucula* is the most widely distributed of the three prairie-forest ecotone taxa extending its range from the eastern prairies into the midwestern states in prairie-like and savannah habitats with scattered disjunct populations reaching southwestern Ontario in the north and Tennessee and the Carolinas further to the south and east.

In November 2010 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010) assessed the status of Showy Goldenrod, and the northwestern Ontario *Solidago pallida* population was assessed as Threatened in Canada (under the name "Showy Goldenrod - Boreal population"). The population has also been assessed by the Committee on the Status of Species at Risk in Ontario (2011) as Threatened in Ontario and it is protected under the Ontario Endangered Species Act, 2007.

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## TYPIFICATION OF *SOLIDAGO GRACILLIMA* (ASTERACEAE: ASTEREAE) AND APPLICATION OF THE NAME

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### ABSTRACT

Variations in application of the name *Solidago gracillima* have compounded confusion over what to include in synonymy under the name. It is regarded here as a species distinct from all those previously included in its synonymy. The holotype shows a diagnostically large inflorescence a few long branches; probable isotypes are variants with smaller, compact inflorescences without elongated lower branches. Morphological features of *S. gracillima* are discussed and compared with other species in *Solidago* subsect. *Maritimae*.

**KEY WORDS:** *Solidago gracillima*, *Solidago austrina*, *Solidago stricta*, *Solidago* subsect. *Maritimae*

*Solidago gracillima* Torr. & A. Gray is a goldenrod species native to the outer edge of the piedmont and the Fall Line counties of South Carolina, Georgia, Florida, and possibly North Carolina. It is a member of *Solidago* subsect. *Maritimae* (Torr. & A. Gray) G.L. Nesom, a group of bog-, marsh, and seasonally wetland goldenrods with lower stem and basal rosette leaves that have petioles sheathing the stem (Semple & Cook 2006). It has been treated as a relatively narrowly defined species distinct from *S. stricta* Ait. and *S. austrina* Small (Small 1903; Cronquist 1968), as a weakly distinct species "perhaps not specifically distinct" from *S. stricta* (Radford et al. 1968), as a broadly defined species including *S. austrina* and *S. simulans* Fern. (Jones & Coile 1988) and *S. perlonga* Fern. (Cronquist 1980), or as a subspecies within *S. stricta* Ait. (Semple & Cook 2006, including *S. austrina* Small). The confusion is the result of 1) a lack of understanding about inflorescence variation in subsect. *Maritimae*, 2) how many species should be recognized within subsect. *Maritimae*, and 3) how best to distinguish the species that are recognized with the subsection.

*Solidago gracillima* Torr. & A. Gray, Fl. N. Amer. 2(2): 215. 1842. *Solidago stricta* Ait. subsp. *gracillima* (Torr. & Gray) Semple, Sida 20: 1615. 2003. TYPE: USA, Florida. "Middle," *Dr. Chapman s.n.* (holotype: NY!, Fig. 1; probable isotypes: Kew 2 sheets!, NY 3 sheets!).

The holotype, as recognized here, may be the only collection at NY seen by Torrey and Gray and is the only specimen marked "*S. gracillima* n. sp." on a Torr. & Gray, Flora N. Amer. label. It also is the only one with an original, printed annotation of "Syn. Fl. N. Amer." Several other probable duplicates of this collection are now at NY but were originally at Columbia College Herbarium (Fig. 2), Hamilton College Herbarium (Fig. 3), and Columbia University Herbarium (Fig. 4). The latter (as well as the holotype) is annotated as "*Solidago gracillima* TYPE K.M." (K. MacKenzie).

The exact collection locality in Florida is not indicated on any of the *Chapman s.n.* specimens. The species occurs in Panhandle Florida. The Atlas of Florida Vascular Plants (Wunderlin & Hansen 2012) reports collections from Bay, Franklin, Leon, and Wakulla counties, but only collections from Leon County have been seen from Florida by the author.



Figure 1. Holotype of *Solidago gracillima* Torr. & A. Gray, Chapman s.n. (NY).



Figure 2 Probable isotype of *Solidago gracilima*, Chapman s.n. (NY ex Columbia College Herb )

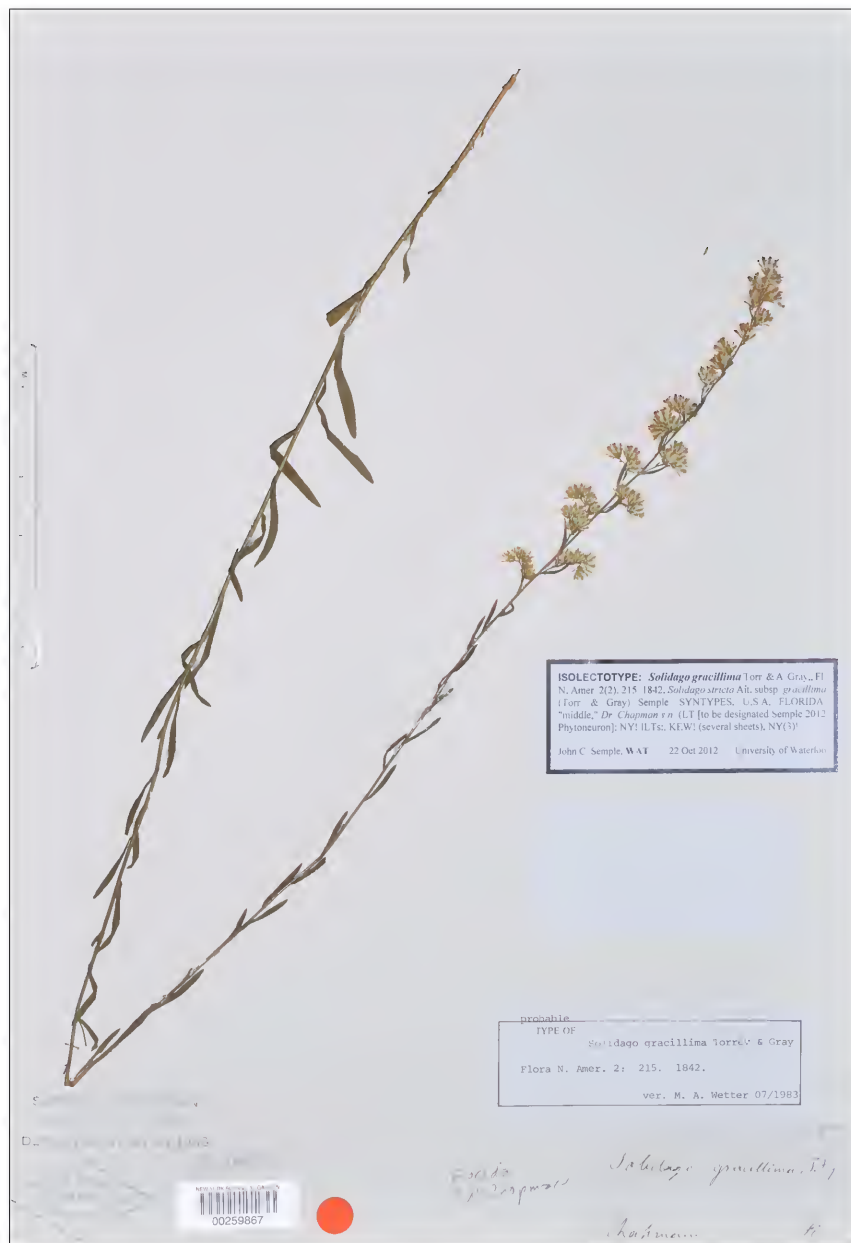


Figure 3. Probable isotype of *Solidago gracillima*, Chapman s.n. (NY ex Hamilton College Herb.).



Figure 4. Probable isotype of *Solidago gracillima*, Chapman s.n. (NY ex Herb. Columbia University).



Type material of *Solidago gracillima* (Chapman s.n. NY, Florida) includes large inflorescences that are very open with a few long branches (holotype NY, Fig. 1; isotype NY, Fig. 2) and smaller compact inflorescences without elongated lower branches (isotypes NY, Figs. 3-4). The same individual can produce different shoots with either large or small inflorescences. Terminal and elongated lateral branches have secund heads on distally arching stems. In comparison, inflorescences of *S. stricta* are elongate and narrow with short usually ascending branches (Fig. 5B). The apex is erect and not secund, unless the entire stem is arching as the inflorescence develops. Then, the entire inflorescence may be one-sided with branches growing upward in the same direction. If the second inflorescence of *S. gracillima* is pressed and dried so that the arching is flattened out, then a small inflorescence could be easily confused as that of *S. stricta*. Inflorescences of *S. austrina* when large have ascending spreading elongated lower branches (Fig. 5A); the apex is often slightly secund. Small inflorescences can be like those of *S. stricta*. Inflorescences of *S. perlonga* are similar to *S. austrina*, but the lower elongated branches are longer and more widely spaced on the stem (Fig. 5C). Smaller inflorescences even on the same clone can be similar to those *S. stricta* (Fig. 5C).

Other species in the subsection have slightly different to obviously different inflorescences. Those of *Solidago uliginosa* (Fig. 5D) have short ascending branches and are club-shaped but can be similar to those of *S. simulans* (Fig. 5E) or even *S. austrina*. Inflorescences of *S. mexicana* (Fig. 5F) and *S. sempervirens* (Fig. 5G) are more secund-pyramidal in general shape. Those of *S. mexicana* have small stem leaves near and into the inflorescence, while those of *S. sempervirens* usually have large leaves just below and into the inflorescence. Those of *S. mexicana* can be similar to *S. stricta*, if the second aspect to the apex is not strongly developed. In all species, size of the inflorescence is critical in determining branching pattern. Strong apical dominance requires lower branches to be relatively distant before the lower branches can elongate into diagnostic patterns. The tendency for botanists to collect specimens that fit on herbarium sheets, i.e., mid to small individual shoots, has resulted in numerous specimens with small inflorescences with non-diagnostic features. This has led to many misidentifications and repeated errors in the literature about the distribution of individual species. Work is underway to accurately map the distributions of all species in the subsection.

Rosette leaves and lower stem leaves of *Solidago gracillima* are shallowly serrate distally or along much of the margin (Fig. 6). The holotype includes several lower stem leaf fragments that are clearly serrate (Fig. 6A). One of the probable isotypes includes a rosette with rounded-spatulate to acute-lanceolate leaves that are long petiolate and serrate distally (Fig. 5D). In the field, lower stem leaves can be similar to the acute, lanceolate rosette leaves and these maintain those traits in cultivated transplants (Fig. 6 B-C respectively, *Semple & Semple 11834*). A few herbarium specimens have larger broader rosette leaves, but under cultivation in a growth chamber such leaves are very robust for the species (Fig. 6 E; seedling rosette leaves, *Anderson 25350 FSU*). Basal leaves of *S. austrina* are similarly serrate but usually larger and oblanceolate, based on observations of lower stem and rosette leaves of herbarium specimens from BRIT, FSU, GA, GH, MO, MT, NY, NCU, USCH, and USF (Thiers, continually undated) and field observations of wild plants in North Carolina, South Carolina, Georgia, and Tennessee. Rosette leaves of *S. stricta* are variable in shape from linear oblanceolate to lanceolate to broadly obovate. However, these are never serrate although sometimes crenate.

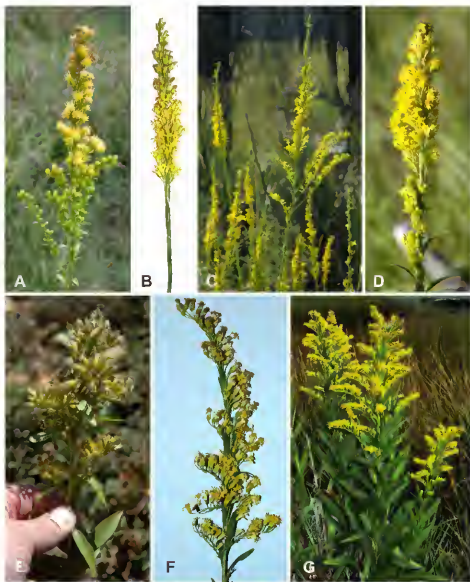


Figure 5. Inflorescence variation in *Solidago* subject *Maritima*: A. *S. austrina*, Semple & Semple 11203, Alabama B. *S. stricta*, Semple 11777, South Carolina C. *S. perlonga*, Semple 11824, New Jersey D. *S. uliginosa*, Semple 11837, Michigan E. *S. simulans*, Semple 11588, North Carolina F. *S. mexicana*, Semple 11651, North Carolina G. *S. sempervirens*, Nova Scotia

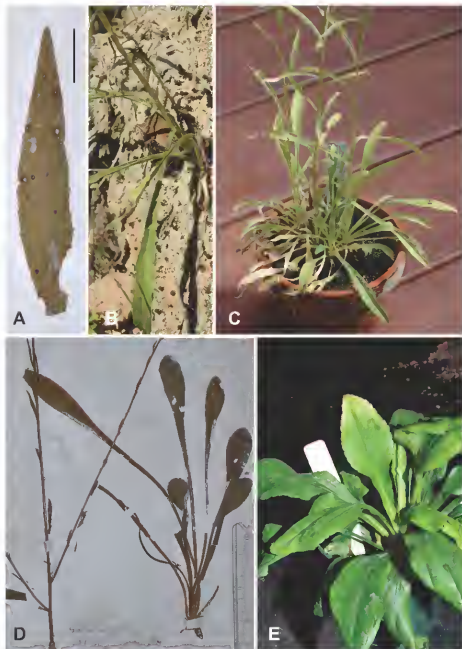


Figure 6. Stem and rosette leaves of *Solidago gracillima*. A. Lower stem leaf fragment, holotype (see Fig. 1), scale bar = 1 cm. B-C. Lower stem leaves of Sample 11834. B. Wild plant growing out of vertical road embankment. C. Cultivated plant grown from rootstock transplanted to WAT. D. Basal rosette leaves of isolectotype (see Fig. 2). E. Growth chamber grown base rosette of seedling from *Anderson 25350* (FSU).

Wild populations of *Solidago gracillima* have been seen in South Carolina and southwestern Georgia. A small population encountered in Barnwell Co., South Carolina, in 1981 (Semple & Scurpt 9814) grew at the top of a bank around a shallow pool in a mixed pine and broadleaf woods. Several populations sampled in southwestern Georgia in 2010 were in habitats that could potentially be wetter in the early season, but were dry in early September. Semple & Semple 11834 (WAT) grew on a sandy clay ridge and on the face of a very steep road cut in an area of mature pine forest and pine plantations (Fig. 7A). Semple & Semple 11836 (WAT) grew in drier, sandy soil at the top of a roadside ditch, while a few individuals of *S. austrina* grew at the bottom of the ditch in wet sandy and mucky soil (Fig. 7B). All collections of *S. austrina* seen in North Carolina, South Carolina, Georgia, and Tennessee grew in ditches, seeps, wet prairie, and heads of tributaries in usually wetter soils.



Figure 7. Habitats of *Solidago gracillima*. A. Semple & Semple 11834, SE of Quitman, Brooks Co., Georgia. B. Semple & Semple 11836, SE of Cairo, Grady Co., Georgia.

Overall, the habitats of *Solidago gracillima* are likely seasonally drier than those of *S. austrina*. Both species can be locally common, but *S. gracillima* is generally less common. I conclude that the tendency to grow in habitats that change from wet to dry over the season is the reason many herbarium collections lack mid and lower stem leaves. The larger leaves become ecologically unsuited to the drier late season conditions and are dropped by the plant. In contrast, most species of subsect. *Maritimae* grow in habitats that are wet to very moist throughout the season. These tend to have lower stem and rosette leaves present at the time of flowering.

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## TERMS FOR SURFACE VESTITURE AND RELIEF OF CUCURBITACEAE FRUITS

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### ABSTRACT

Terminology describing fruit surfaces of Cucurbitaceae is reviewed. The terms aculeate, bristly, echinate, muricate, tuberculate, furrowed, and smooth are defined and illustrated. Hispid, hirsute, pubescent, and villous describe vestiture (trichomes); echinate, aculeate, muricate, furrowed, tuberculate, and smooth refer to features of relief (not trichomes).

**KEY WORDS:** Cucurbitaceae fruits, surface vestiture and relief

In preparation of the taxonomic treatment of Cucurbitaceae for the developing Flora of North America North of Mexico (FNANM) volumes, terminology for describing features of fruit surface in that family was reviewed. Supposing that others might also find it useful toward clarity and consistency, a summary is presented here. Surface feature terms are divided here somewhat arbitrarily into two categories — **vestiture** (descriptions of trichome cover) and **relief** (broadly inclusive, including all terms not directly descriptive of trichome cover). The FNA description of fruit surface for the whole family is "glabrous or with trichome cover (hispid, hirsute, pubescent, villous), smooth or with surface relief (echinate, aculeate, muricate, tuberculate, furrowed)."

In general, definitions from the FNA Glossary (Kiger & Porter 2001) are the most useful for Cucurbitaceae. For each of the terms described below, the etymological derivation is shown and an illustration is provided to show the "typical" (or "lectotypical") condition. The present review draws from glossaries from Asa Gray (1887 = "A. Gray"), Fernald (1950), Lawrence (1955), and Radford et al. (1974), the glossary prepared for FNA authors (Kiger & Porter 2001 = "FNA"), Composition of Scientific Words (Brown 1956), and other miscellaneous sources.

Ambiguity of interpretation exists in some cases, especially with regard to the term "echinate." When the spinelike structures of an echinate surface are very thin in diameter and trichomelike, the condition might just as well be regarded as one of vestiture — hispid or hirsute. For example, echinate fruit surfaces in *Sicyos* are covered with trichomelike structures, but these are not clearly homologous with trichomes. In fact, they themselves, individually, may have surficial trichomes or trichomelike features. Fruits of some *Sicyos* species have both spinules and trichomes.

A correlated ambiguity extends to the terms "bristles" and "bristly," which have sometimes been used at least with reference to *Sicyos* (e.g., Nesom 2011).

**bristly** (Anglo-Saxon, *byrst*, hair) – Beset with bristles, hirsute, hispid, setose, bristles "stiff, sharp hairs, or any very slender bodies of similar appearance" (A. Gray), "bearing relatively long and slender, more or less straight, terete, fine-pointed stiff hairs" (FNA).

Because most definitions of bristle equate it with a hair, I have not used the term in the FNA treatment. Instead, a thin spinelike structure is referred to as a "spinule" (diminutive of spine). Because "hair" lacks the technical precision of "trichome," however, bristle and spinule might justifiably be used interchangeably.

**VESTITURE** Types of trichome cover.

**hispid, hirsute, pubescent, villous** - Standard terms defined in many botanical glossaries. See illustrations in Lawrence (1955). *Thladiantha dubia*.

**RELIEF** Features based on surface topology and epidermal outgrowths or excrescences (excluding trichomes).

**echinate** (Greek, *echmos*, sea urchin, hedgehog) Figure 1A. Bristly, prickly, spinulose; "armed with prickles (like a hedgehog)" (A. Gray); "covered with spines; spinose, spiny" (FNA). *Brandegea*, *Cucumis*, *Cyclanthera*, *Echinocystis*, *Echinopepon*, *Marah*, *Sicyos*.

**aculeate** (Latin, *aculeus*, sting, spur) Figure 1B. Having any sharp-pointed structure; prickly, spinose, spiny; "armed with prickles, i.e., *aculer*; as the Rose and Brier (A. Gray); "having slender, stiff, sharp projections oriented in the general plane of the structure" (FNA). *Cucumis*.

**muricate/muriculate** (Latin, *muricatus*, pointed or spiny like the surface of a murex shell (a kind of mollusk)) Figure 1C. "Beset with short and hard or prickly points" (A. Gray); covered with short, sharp points; "rough with short, hard points or protuberances; with short, hard, more or less acute, transversely round protrusions overall" (FNA). *Cucumis*, *Ecballium*, *Momordica*. *Ecballium elaterium* has short conical tubercles abruptly drawn out apically into a thin, hairlike extension – it seems likely that these structures are homologous with echinate spines common elsewhere in the family, but I have termed the surface as "muricate-hispid to muricate-hirsute." *Cucumis*, *Momordica*.

**furrowed** (Middle English, *fur(o)we*, *furgh*) Figure 2A. With furrows, "elongate depression[s] that [are] relatively shallow and narrow" (FNA). *Cucurbita*.

**tuberculate** (Latin, *tuberculum*, diminutive of *tuber*) Figure 2B. With small, rounded projections, swellings, or protuberances; "bearing excrescences or pimples" (A. Gray); "verruccose, warty, covered with small, relatively broad, irregularly shaped, obtuse projections" (FNA). *Cucurbita*.

**smooth** (Old English, *smōth*, akin to Old Saxon, *smōthī*) Figure 2C. Having a surface free from irregularities, roughness, or projections, even; "even or unrelieved overall. Strictly applied, this term refers only to the surface proper; however, it is often used to mean glabrous as well" (FNA). The smooth condition in Figure 2C at least has minimal surface relief, and it also illustrates the how the term may refer to both vestiture and relief. Species in most genera.

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Figure 1. A. Echinat surface; European hedgehog, *Erinaceus europaeus*; B. Aculeate surface; prickles of *Rosa* stem; C. Muricate surface; individuals of purple dye-murex, *Bolinus brandaris* (originally *Murex brandaris* L.)





Figure 2 A Furrowed, vestiture of *Gossypium hirsutum* B Tuberculate, glabrous, a cultivar of *Cucurbita melopepo* C Smooth (or mostly lacking relief), glabrous (perhaps artificially)

***SYMPHYOTRICHUM PRATENSE* (ASTERACEAE):  
NEW FOR THE FLORA OF OKLAHOMA**

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**ABSTRACT**

*Symphyotrichum pratense* is reported new for Oklahoma from a site east of Broken Bow, McCurtain County, in the extreme southeastern corner of the state. In 2010 this species was collected on a degraded limestone cedar glade, a habitat more typical of populations in the eastern United States rather than those in nearby Texas. This species is rare everywhere except Texas and Louisiana and should be considered imperiled in Oklahoma.

**KEY WORDS:** Asteraceae, *Symphyotrichum*, *Symphyotrichum pratense*, McCurtain Co., Oklahoma

*Symphyotrichum pratense* (Raf.) Nesom, barrens silky aster, is native to dry, sandy, saline, or rocky barrens and prairies or prairie-like habitats in the southeastern USA (Jones et al. 2008). It is closely related to *S. sericeum*, from which it can be distinguished by its larger involucre, less sericeous phyllaries, and phyllary morphology. In *S. pratense* the distal, green portion of the largest phyllaries are much longer than the proximal, indurate portion, while in *S. sericeum* the reverse is true—though in occasional individuals of the latter the two portions are about equal (Jones et al. 2008).

Except for a small region of central Texas, *Symphyotrichum pratense* and *S. sericeum* are allopatric. According to the excellent synopsis provided by Jones et al. (2008), *S. sericeum* is found primarily from Arkansas and Oklahoma north to southern Canada, western Michigan and Indiana, with disjunct populations in central Texas. The core range of the *S. pratense* lies in eastern Texas and western Louisiana with disjunct populations farther east. In Texas this species is associated more frequently with sandy and sandy loam soils—particularly those of the post oak savannah and the piney woods as well as coastal prairies—and less commonly with the calcareous clays of the blackland prairie. In contrast, Louisiana locations are in blackland prairie remnants, chalk hills, and calcareous clays as well as pine flatwoods. On the coastal plain of southern Arkansas, where it has apparently been mostly extirpated, it grows in open saline barrens. Farther east, the species grows mostly in calcareous chalk barrens, cedar glades, and limestone outcrops. These widely disjunct populations are in central Kentucky, scattered in middle Tennessee, western Virginia, western North Carolina (historically), northwest and south central Georgia, as well as the Florida Panhandle, northern and western Alabama, and east central Mississippi (Jones et al. 2008).

Prior to this discovery, *Symphyotrichum pratense* was not known from Oklahoma (Jones 1992; Jones et al. 2008; BONAP 2012). On 27 October 2010 Arbour collected the species east of Broken Bow, in McCurtain County, Oklahoma, on a subdivided tract that was for sale. Two days later White visited the site and counted around a dozen plants and obtained numerous characteristic photos and a partial specimen of a flowering head, which was scanned at high resolution. White and Arbour revisited this site 5 October 2012 and White collected another voucher.



Voucher specimens: **Oklahoma.** McCurtain Co.: 5.25 mi E of Broken Bow on US 70 and 0.5 mi N on county road to Mt Fork Park ~50-80 yards E of road in open glade, 34° 02' 91.40 N, 94° 39' 13.50" W, 27 Oct 2010, *Arbour s.n.* (OKL); 5 Oct. 2012, *White s.n.* (BAYLU).



Figure 1. A (left). *Symphyotrichum pratense* scanned at 3600 dpi from a collection made, but not preserved, 29 Oct 2010. Note that the distal green portions of the largest phyllaries are approximately 2/3 the length of the indurate proximal portions in this individual. B (right). Macrophotograph of *M. White s.n.* (BAYLU) collected 5 Oct 2012. Note the marginal cilia on the phyllaries. Photo by Matt White.

The Oklahoma site is a degraded cedar glade with thin soils over limestone. *Symphyotrichum pratense* is rare and occurs with *Schizachyrium scoparium*, *Dalea compacta* var. *compacta*, *Physostegia virginiana*, *Rudbeckia missouriensis*, *Liatris squarrosa* var. *glabrata*, *Liatris pycnostachya*, *Spiranthes magnicamporum*, *Manfreda virginica* subsp. *virginica*, *Eupatorium altissimum*, *Silphium laciniatum*, *Stenaria nigricans* and *Carex microdonta*.

The habitat at this site is in stark contrast to characteristic habitat on the coastal plain in neighboring Bowie County, Texas where *Symphyotrichum pratense* grows in abundance (M. White pers. obs.) in two “pocket prairies” remnants. The habitat at these prairie remnants was described by



Singhurst et al. (2011). In contrast, the McCurtain County site is on the edge of the Interior Highlands and the habitat more like that found in the disjunct eastern populations with many of the same plant associates.

When the species was discovered, the timber around the glade had been clearcut and the land subdivided and offered for sale, and some of the surrounding lots had been developed into domestic lots. The glade, however, was intact. It was subsequently sold and the scattered cedars were cleared with a dozer and pushed into piles although some of the remnant vegetation still existed 5 October 2012 when a search was conducted by Arbour and White and three plants were located.



Figure 1. *Symphyotrichum pratense*. Close up of flowering head and phyllaries. McCurtain County, Oklahoma. 29 Oct 2010. Photo by Matt White.

According to BONAP data (2012) the discovery of *Symphyotrichum pratense* in Oklahoma brings the number of *Symphyotrichum* species currently listed for the state to 26, with 17 in McCurtain County alone. Everywhere except Texas and Louisiana, *S. pratense* is considered rare. In Alabama, Georgia, Mississippi, Tennessee, and Virginia it is considered S1 or critically imperiled with fewer than five occurrences (Jones et al. 2008). Oklahoma should be added to the list because currently the species is known from one site and the continued survival of the population is tenuous. Additional populations should be actively sought on similar habitats on nearby timberlands.

#### ACKNOWLEDGEMENTS

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## **PITYOPSIS OLIGANTHA (ASTERACEAE) NEW TO TEXAS**

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### **ABSTRACT**

*Pityopsis oligantha*, Large-flowered Goldenaster, is documented as new to Texas. The species was encountered and collected in the West Gulf Coastal Plain Wetland Longleaf Pine Savannah of deep east Texas (Jasper County).

**KEY WORDS:** Asteraceae, *Pityopsis*, Longleaf Pine savannah, Texas.

In the Manual of the Vascular Plants of Texas, Correll and Johnston (1970) included *Pityopsis oligantha* (Chapm. ex Torr. & A. Gray) Small under the synonym *Heterothea oligantha* (Chapm.) Harms within the treatment of that genus. They mentioned that the species was "not yet noted from Tex. but possibly to be encountered [italics inserted] in extreme e. cos." Doubtless, the "record" of this species in the state originated here and was later included in Hatch et al. (1990) and Jones et al. (1997), both being checklists of the vascular plants of the state. It is not known why Correll and Johnson would consider the species as possibly occurring in Texas, for at that time (pre-1970), the distribution of *P. oligantha* was known to be west Florida and adjacent Alabama and Georgia (Small 1933). The lack of a supporting specimen has resulted in the species no longer being included as a part of the Texas flora (Cronquist 1980; Turner et al. 2003; Semple 2006; USDA, NRCS 2012). Recently, a specimen (Figure 1) collected by the authors in the Longleaf Pine savannah in 2000 has been determined to be *Pityopsis oligantha*. This specimen, cited following, substantiates the presence of the species in the state.

**TEXAS.** Jasper Co.: Kirbyville Airport, Kirbyville, flat periodically mowed area; heads yellow, 24 Sep 2000, W.C. Holmes & J.R. Singhurst 11100 (BAYLU). Figure 1.

*Pityopsis oligantha* in Texas was documented in a globally rare (G1G2S1S2) West Gulf Coastal Plain Wetland Longleaf Pine Savanna community, occurring on saline soils (Brimstone silt loam, a Glossic Natraqualf) of the Pleistocene prairie terrace, with an open canopy of *Pinus palustris*. The dominants include *Pinus palustris*, *Sporobolus silveanus*, *Muhlenbergia capillaris*, and *Rhynchospora* spp. Important herbaceous species include *Agalinis fasciculata*, *Andropogon capillipes*, *Arnoglossum ovatum*, *Asclepias verticillata*, *Bigelovia nuttallii*, *Chaetopappa asteroides*, *Dalea candida* var. *candida*, *Desmodium* sp., *Dichanthelium* spp., *Echinacea sanguinea*, *Eurybia hemisphericum*, *Eupatorium leucolepis*, *E. rotundifolia*, *Eryngium integrifolium*, *Evolvulus sericeus*, *Hedyotis nigricans*, *Pycnanthemum tenuifolium*, *Iva angustifolia*, *Liatris acidota*, *Liatris punctata*, *Liatris pycnostachya*, *Lobelia puberula*, *Marshallia caespitosa*, *Mecardonia acuminata*, *Muhlenbergia capillaris*, *Neptunia lutea*, *Panicum virgatum*, *Paspalum floridanum*, *Physostegia*



Figure 1 *Ptyopsis oligantha* (Holmes & Singhurst 11100, BAYLU). Photo by Darrel Vodopich.

*virginiana* subsp. *praemorsa*, *Polygala ramosa*, *Rhexia lutea*, *Rhexia virginica*, *Rhynchospora colorata*, *R. divergens*, *R. elliptica*, *R. glomerata*, *R. gracilentia*, *R. plumosa*, *R. microcarpa*, *Rudbeckia texana*, *Sabatia campanulata*, *Scutellaria integrifolia*, *Schizachyrium tenerum*, *Solidago sempervirens*, *Spartina spartinae*, *Sporobolus junceus*, *S. pyramidatus*, *S. stiveanus*, *S. compositus* var. *compositus*, and *Stylisma aquatica*.

The major difficulty in classification of *Pityopsis* and related genera (*Heterotheca* and *Chrysopsis*) has been generic circumscription (see Gandhi and Thomas 1989 for an overview). However, specific recognition has seemingly been rather stable. *Pityopsis oligantha* is similar to *P. graminifolia* (Michx.) Nutt., which has two recognized varieties in Texas (Semple 2006). The latter species is widely distributed in the Pineywoods region of the state and also much of the Post Oak Savannas, while *P. oligantha* is known only from the specimen cited above. The specimen was identified by use of the keys in Correll and Johnston (1970), Cronquist (1980), Gandhi and Thomas (1989) and Semple (2006), all keying to species with equal facility. Following we have produced a key derived from these sources.

1. Peduncles and involucre densely stipitate-glandular; cauline leaves mostly 2–7; heads 1–6  
..... *Pityopsis oligantha*
1. Peduncles and involucre not densely glandular-hairy; cauline leaves generally 10 or more,  
heads mostly 10 or more ..... *Pityopsis graminifolia*

Currently, *Pityopsis oligantha* has a Global Status of G3 (vulnerable) by reason of [as stated] being reported from four southern states of the USA, but with abundance not being known (Nature Serve 2012). These states are Florida, where it may be locally abundant in the panhandle (western Florida), Georgia, Alabama, and Mississippi. Not cited is Louisiana, where the species has been reported in Rapides Parish by Thomas and Allen (1996) and in eight parishes by USDA, NRCS (2012). Major threats to the species are land-use conversions, habitat fragmentation, succession, and forest management practices (Southern Appalachian Species Viability Project 2002). The species is apparently native in Texas and is considered to be a rare peripheral in the state (G3S1). It is presumably limited to longleaf pine savannas in southeast Texas.

#### ACKNOWLEDGEMENTS

We wish to thank Garrie P. Landry of the Herbarium, Biology Department, University of Louisiana at Lafayette, for providing digital photographs of *Thieret 25144* (LAF) from Rapides Parish, Louisiana, the specimen cited in Thomas and Allen (1996) as *Pityopsis oligantha*. Darrell Vodopich of the Biology Department, Baylor University, contributed to this study by taking the photograph of the specimen and processing it for publication.

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## NEOTYPIFICATION OF *SOLIDAGO BUCKLEYI* (ASTERACEAE: ASTEREAE) AND OBSERVATIONS ON ITS DISTRIBUTION

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### ABSTRACT

A neotype specimen is designated here for *Solidago buckleyi* due to the lack of original material. The Buckley collection (*Buckley s.n.* NY ex Herb. LeRoy) from Alabama presumed to be the holotype is not the specimen seen by Torrey and A. Gray in the early 1840s. Therefore, *E.J. Palmer 31579* (NY) is designated as the neotype for the species name.

**KEY WORDS:** *Solidago buckleyi*, neotypification, multivariate morphometrics

*Solidago buckleyi* Torr. & A. Gray (1842) is a member of the subsect. *Thyrsoflorae* A. Gray and is similar to *S. petiolaris* Ait. (Semple & Cook 2006). Buckley's goldenrod is native to southern Missouri, southern Illinois, northwestern Kentucky, and extreme southwestern Indiana. In the protologue of *S. buckleyi*, a single collection was cited: "Interior of Alabama, Mr. S.B. Buckley! Oct." Nesom (1990) included a symbol for *S. buckleyi* from Jasper Co., Georgia, on his distribution map. There are problems with both the Alabama specimen and the Georgia specimen.

A putative collection of *Solidago buckleyi* from Jasper Co., Georgia, was seen in a loan from NY (Thiers, continuous update). The specimen (*Porter s.n.*) was labeled by Porter as *S. buckleyi* and annotated by Nesom as *S. buckleyi* in 1990. However, the collection is an unrecognized isotype of *Solidago porteri* Small and is not a specimen of *S. buckleyi*. Therefore, the report of *S. buckleyi* from Georgia is an error. A manuscript on the rediscovery of *S. porteri* is in preparation by J.C. Semple and D. Estes.

The presumed holotype of *Solidago buckleyi* consists of a few fragments (Fig. 1), which makes the identity uncertain. Posted on the New York Botanical Garden web site is a digital photograph of the specimen (*Buckley s.n.*), which shows a folded card in the open position to reveal the fragments of stem, leaves and inflorescence. However, the front face of the card contains critical information regarding the eligibility of this specimen to be the holotype of *S. buckleyi*. In manuscript on the card are the following: "Solidago Buckleyi" and "Ala 1836 Buckley." At the top of the card is the printed label "New York Botanical Garden / Herbarium of Mr. P.V. LeRoy / Purchased 1896" (see Fig. 1). Since the location datum does not mention "Interior of Alabama" and since this particular specimen did not come into the possession of the NY Herbarium until 1896 and was not seen by Torrey and/or A. Gray, the specimen does not qualify to be the holotype of *S. buckleyi*. Therefore, we do not consider the NY specimen as part of the original material. Furthermore, it is also not certain to what species the NY ex LeRoy Herbarium specimen belongs due to the nature of the fragments. It may belong to *S. buckleyi*, but we cannot be certain. The fact that the two large

leaves have large teeth is not a trait exclusive to *S. buckleyi* sensu authors. Therefore, we exclude the NY specimen from consideration for any typification and opt for a neotypification

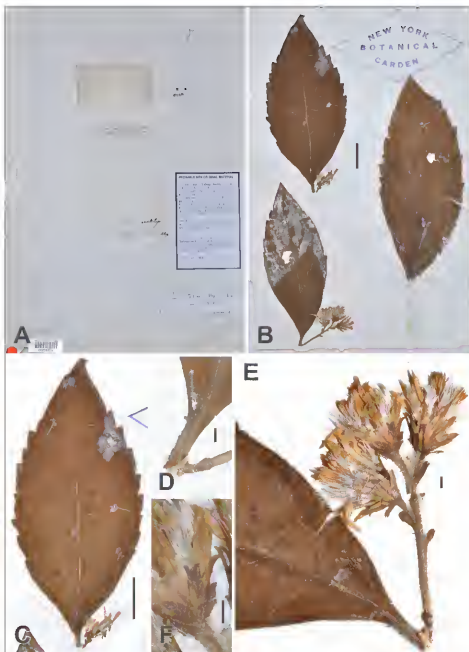


Figure 1. Putative holotype of *Solidago buckleyi* (Buckley s.n. NY) A B C D

A revised dot distribution of *Solidago buckleyi* has been prepared (Fig. 2). It includes all collections seen and additional literature reports that are likely to be correct. The location of *Buckley s.n.* (NY) is indicated with a question mark as the exact location is unknown.

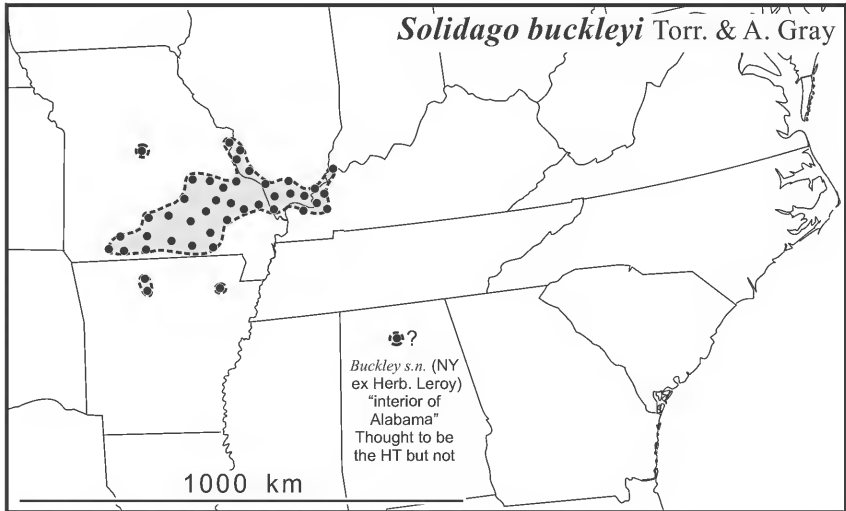


Figure 2. Distribution of *Solidago buckleyi* based on collections seen and literature

### Neotypification

*Solidago buckleyi* Torr. & A. Gray, Fl. N. Amer. 2(2): 198. 1842. *Aster buckleyi* (Torr. & A. Gray) Kuntze, Revis. Gen. Pl. 1: 317. 1891. **TYPE: USA. Alabama.** "interior of," Mr. S.B. Buckley *s.n.*, not located. **NEOTYPE** (designated here): **USA. Missouri.** St. Francois Co.; thickets along small rock creek, near Bismarck, 6 Sep 1926, *E.J. Palmer 31579* (NY, Figs. 3 and 4).

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Figure 3. Neotype of *Solidago buckleyi* (E. J. Palmer 31579 NY).

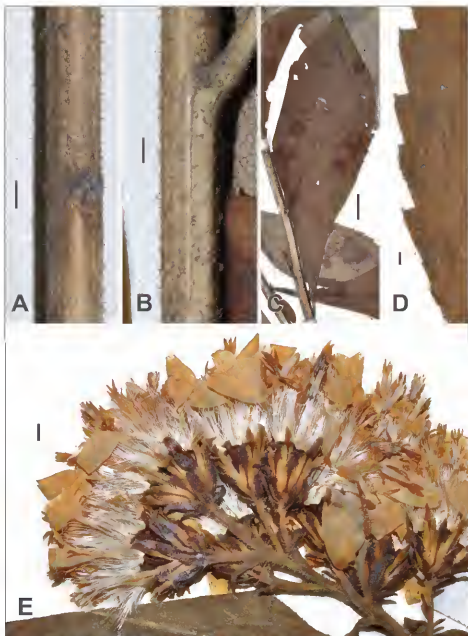


Figure 4. Details of the neotype of *Solidago buckleyi* (E. J. Palmer 31579 NY).

## **SOLIDAGO JEJUNIFOLIA (ASTERACEAE: ASTEREAE) NEW TO MANITOBA AND CANADA**

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### **ABSTRACT**

The presence of *Solidago jejunifolia* is reported for the first time in Canada, from south of Winnipeg, Manitoba, near the Minnesota border. This species has not been given special status in Canada but should be considered endangered.

**KEY WORDS:** *Solidago jejunifolia*, *Solidago speciosa*, *Solidago rigidnucula*, *Solidago pallida*, Manitoba, Canada, rare plants

A collection of what was thought to possibly be *Solidago uliginosa* Nutt. was made by B.A. Ford and D. and C.E. Punter on 1 September 1996 from northwest of Senkiw, north of Roseau River, Manitoba, Canada (49° 12' 40" N, 96° 53' 42" W). A digital image of the collection Ford, Punter, & Punter 9656, WTN (Fig. 1) was sent to J.C.S. for identification in the fall of 2012. The specimen was immediately recognized as *S. jejunifolia* Steele, a member of the *S. speciosa* Nutt. complex, on the basis of it having typical *Solidago* subsect. *Squarrosae* A. Gray traits of large basal stem and rosette leaves and a club to wand-shaped inflorescence and in having the diagnostic long, narrow petioles of *S. jejunifolia* (Fig. 2).

*Solidago jejunifolia* was treated as a synonym of *S. speciosa* var. *speciosa* by Semple and Cook (2006). However, a multivariate morphometric analysis of the *S. speciosa* complex and all taxa in subsect. *Squarrosae*, and separate multivariate studies on all subsections of the genus, have resulted in a change in understanding of species limits in the genus. The *S. speciosa* complex is now divided into four species: *S. speciosa*, *S. jejunifolia*, *S. pallida* (Porter) Rydb., and *S. rigidnucula* (Torr. & A. Gray) Porter (see Semple et al. 2012).

*Solidago jejunifolia* grows in tall grass prairies, open areas in dry jack pine (*Pinus banksiana*) forests (Fig. 3A) and regenerating jack pine forests, sand barrens, open pine plantings, dry prairie/savannahs, oak savannahs, roadsides, sandy dune areas, old fields, roadsides, road right-of-way embankments next to red pine (*Pinus resinosa*) and jack pine trees (Fig. 3B); based on herbarium label data (MIN, WAT, WIN; Thiers, continuously updated). It has been collected on reddish and pale brown sandy or gravelly soils.

*Solidago jejunifolia* has not been given special conservation status in Canada or Manitoba, but it should be considered endangered (N1, S1, respectively) based on Nature Conservancy rankings (<http://www.natureserve.org/explorer/ranking.htm>). The status of the single known Manitoba population is uncertain and the habitat may have been converted to agricultural uses.



Figure 1. *Solidago jejunifolia* voucher (Ford, Punter, & Punter 9656, WIN).



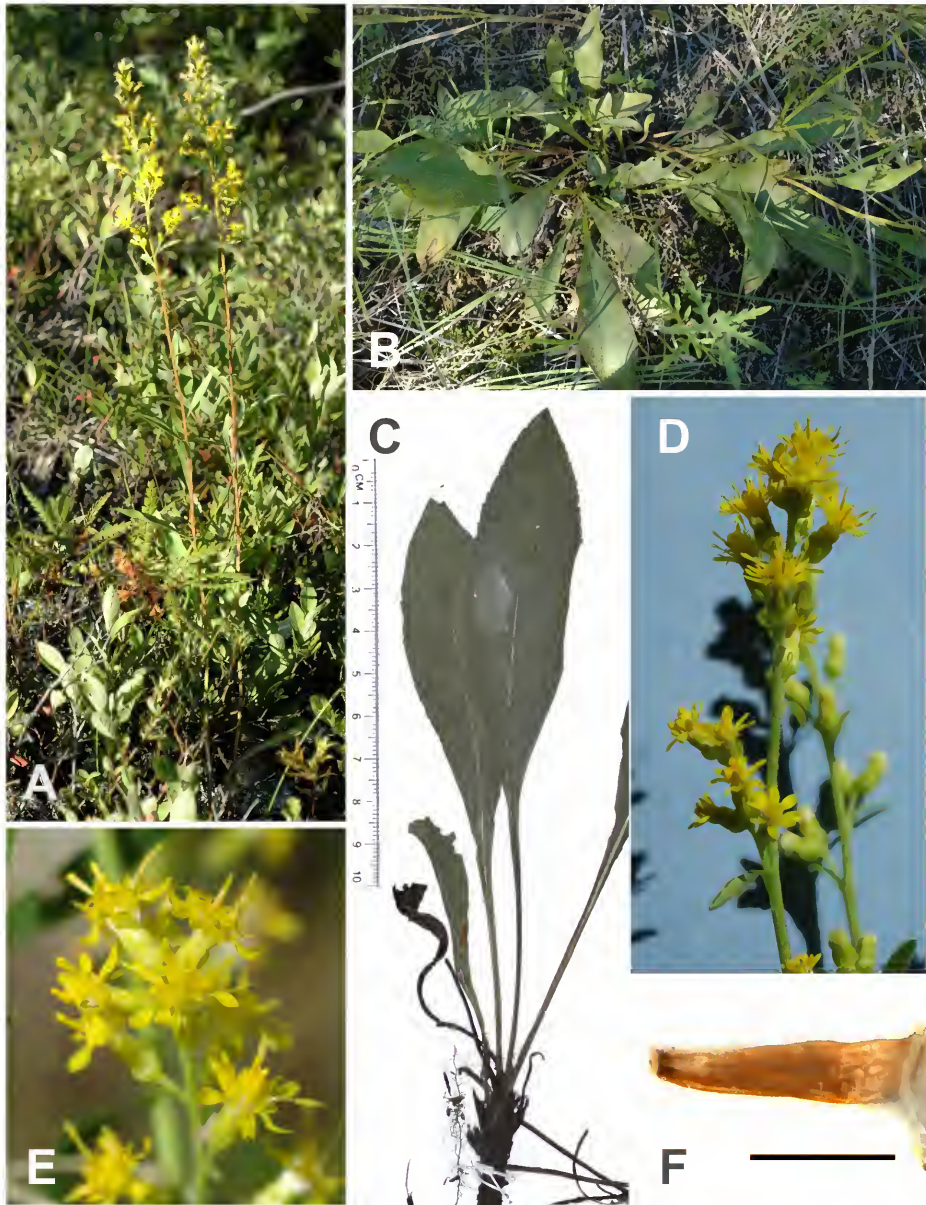


Figure 2. *Solidago jejunifolia* morphology. **A.** Shoots, Cheboygan Co., Michigan (*Seiple 11844*, WAT). **B.** Basal leaves, Sherburne Co., Minnesota (*Seiple 11850*, WAT). **C.** Basal leaves (*Converse 1906*, MIN). **D.** Flowering heads, Douglas Co., Wisconsin (*Seiple 11848*, WAT). **E.** Flowering heads, Cheboygan Co., Michigan (*Seiple 11839*, WAT). **F.** Cypsel (*Seiple 11150*, WAT); scale bar = 1 mm.

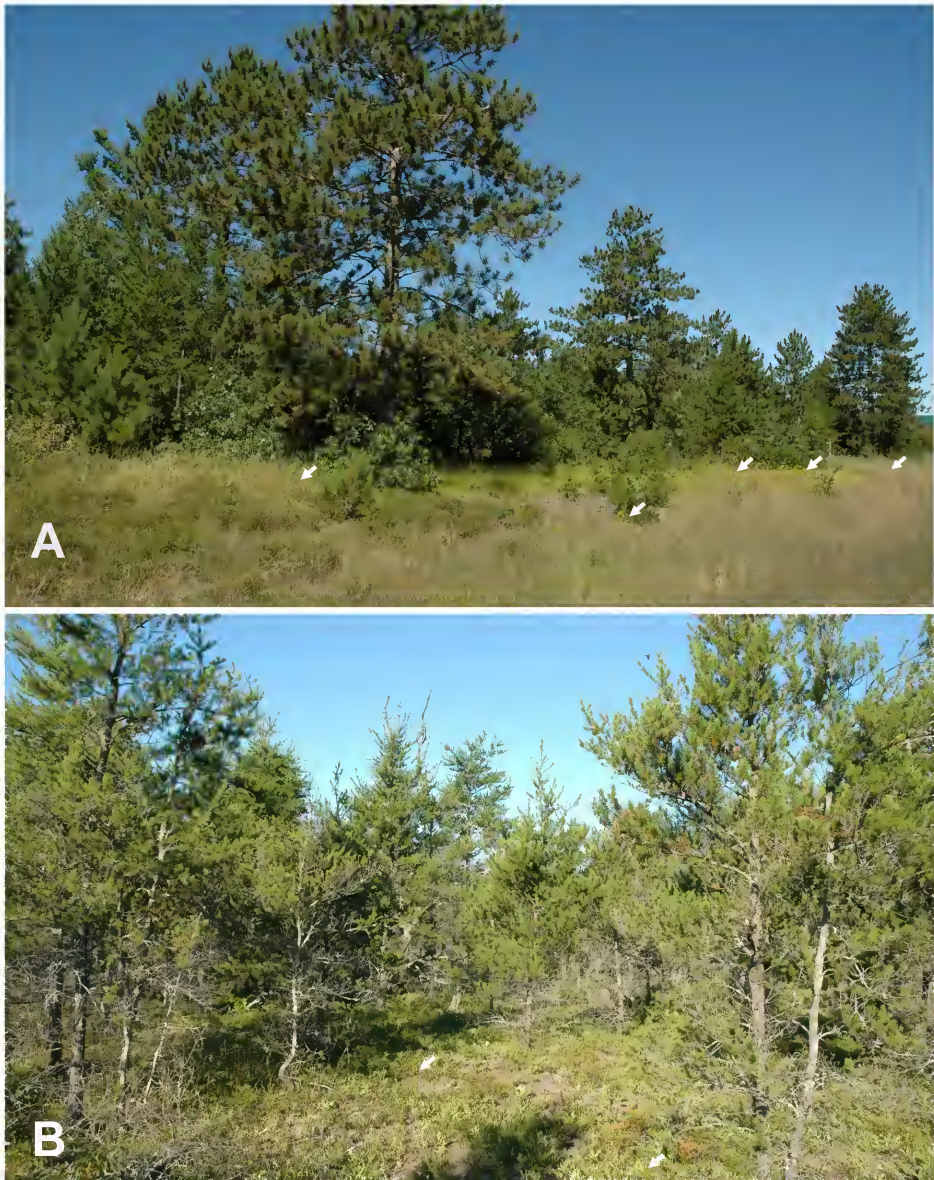


Figure 3. *Solidago jejuniifolia* habitats. **A.** Douglas Co., Wisconsin (*Semple 11848*, WAT). **B.** Delta Co., Michigan (*Semple 11844*, WAT). Arrows indicate locations of some of the plants in the populations.

## ACKNOWLEDGEMENTS

This work was supported by a Natural Sciences and Engineering Research Council of Canada Discovery Grant to J.C.S. Joan Venn is thanked for her curatorial assistance with loans. The following herbaria are thanked for data and for loaning specimens of subsect. *Squarrosae*: MIN, WAT, and WIN. D. Punter assisted with fieldwork in Manitoba.

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STUDIES OF NEOTROPICAL COMPOSITAE-VIII.  
THE NEW COMBINATION *PSEUDONOSSERIS GLANDULOSA*  
AND REVISION OF *PSEUDONOSSERIS* (LIABAEAE)

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ABSTRACT

The new combination *Pseudonosseris glandulosa* (Compositae: Liabaeae: Paranepheleinae) is proposed and *Pseudonosseris* revised with two species recognized, both found in Andean Peru and Bolivia only in and south of the Huancabamba Depression. Both species of *Pseudonosseris* were described originally in *Onoseris* (Mutisieae). Also included are images of holotypes, representative specimens, and capitula of both species of *Pseudonosseris*, as well as a distribution map.

**KEY WORDS:** Andes, Asteraceae, Bolivia, Compositae, Huancabamba Depression, Peru, Liabaeae, *Onoseris*, Pleistocene climatic oscillations, *Pseudonosseris discolor*, *Pseudonosseris glandulosa*, Mutisieae, Paranepheleinae

Liabaeae was described by Rydberg (1927) to accommodate five genera, including *Liabum* Adans. (Compositae), an opposite-leaved radiate-capitulate American genus having vernonioid styles (Cassini 1823). The styles of Liabaeae resemble technically those of Vernoniaceae and Cichoriaceae by their adaxial continuous stigmatic surfaces and abaxial branch sweeping papillae extending downward onto the distal portion of trunk (Robinson 1983; Pruski & Sancho 2004). Robinson and Brettell (1974) recognized 14 genera of Liabaeae with several segregates culled mostly from *Liabum* s. lat., including *Pseudonosseris* H. Rob. & Brettell (Compositae: Liabaeae: Paranepheleinae). Tribe Liabaeae now contains 19 genera, with 13 of these genera occurring in Peru, its center of diversity (Robinson 1978, 1983; Pruski & Sancho 2004; Soejima et al. 2008; Robinson & Funk 2011).

Robinson (1983) placed only *Pseudonosseris* and *Paranepheleus* Poepp. into his newly described subtribe Paranepheleinae. Funk et al. (2012) expand Paranepheleinae to include six genera, including *Erato* DC. which extends into Central America. Soejima et al. (2008) dated origins of the *Pseudonosseris*-*Paranepheleus* clade to the Miocene (very approximately to 13 Ma). Thus, *Pseudonosseris* and *Paranepheleus* (or their immediate precursors) diversified well after the significant central Andean uplifts (Oligocene, ca. 30 Ma), perhaps concurrently with major northern Andean orogeny (Pliocene-Pleistocene, ca. 3–5 Ma) and increased habitat heterogeneity in both the central and northern Andes (Soejima et al. 2008).

The central and northern Andes are discontinuous roughly at the Huancabamba Depression (approximately between 5° and 6° S latitude in the deep upper Río Marañón and Río Chamaya basins, continuing westward over the Abra de Porculla at ca. 2145 m, and down to Olmos), an oft-cited biogeographic barrier for some plant distributions as well as an endemism center (Wurdack 1953; Simpson 1975; Molau 1988; Funk et al. 1995; Ayers 1999; Weigend 2002). It is perhaps noteworthy that, although climatic fluctuations in the Pleistocene lowered (in glacial maxima) vegetational zones facilitating some migrations across the Huancabamba Depression, core subtribal Paranepheleinae members *Pseudonosseris* and *Paranepheleus* remain known from only in and south of the Huancabamba Depression (Robinson 1978, 1983; Soejima et al. 2008). While these two genera may have radiated only after the onset of Pleistocene climatic oscillations, the Huancabamba Depression may still have acted (either well before or during the Pleistocene) as a barrier to migration.



Figure 1. Representative specimen of *Pseudonoseris discolor* (Muschl.) H. Rob. & Brettell (Araujo 4194, MO).



Figure 2. Close-up of capitula of *Pseudonoseris* showing the linear-lanceolate phyllaries and the long-stipitate-glandular peduncles. A. *Pseudonoseris discolor* (Muschl.) H. Rob. & Brettell. B. *Pseudonoseris glandulosa* (Hieron.) Pruski. (A. Araujo 4194, MO, B. Smith & Cabanillas 7303, MO). [The scale bar on the right has increments of 1 cm.]

Here, *Pseudonoseris* is revised, the new combination *P. glandulosa* is proposed, and this high-elevation Andean genus is recognized as containing only two species. *Pseudonoseris striata* and *P. szyszowiczii* were each usually recognized elsewhere (Robinson & Brettell 1974; Robinson 1983; Beltrán et al. 2006; Soejima et al. 2008), but both are reduced here to synonymy of *P. glandulosa*. *Pseudonoseris glandulosa* and *P. discolor* are disjunct from each other by about 1100 km (Fig. 3).

**PSEUDONOSERIS** H. Rob. & Brettell, *Phytologia* 28: 59. 1974. TYPE: *Liabum striatum* Cuatrec. [= *Pseudonoseris glandulosa* (Hieron.) Pruski]

**Small perennial subscapose herbs**, leaves in basal rosettes or stems leafy proximally, with milky latex, scape typically with a low arachnoid-pubescent and long stipitate-glandular trichomes held well above arachnoid pubescence. **Leaves** opposite, sometimes in basal or cauline rosettes, sessile, blade subentire to lyrate-pinnatifid, lanceolate to obovate, chartaceous to stiffly so, venation pinnate, surfaces discolorous, adaxial surface smooth to rugose, pubescent to glabrate, abaxial surface cinereous-griseous-tomentose (sometimes drying fulvous), base slightly clasping. **Capitulescence** subscapose, paucicapitulate, open cymose with alternate branching, peduncles elongate, long-stipitate-glandular. **Capitula** radiate, involucre campanulate, phyllaries ca. 40, weakly imbricate, graduate, 3–5-seriate, linear-lanceolate, long-stipitate-glandular, outer ones acute apically, often spreading in fruit, inner ones long-attenuate apically, clinanthium (phoranthium or receptacle) epaleate, low-alveolate, subglabrous. **Ray florets** 12–26, pistillate, 1-seriate; corolla orangish-yellow to scarlet, tube pilose-villous, limb linear-oblancheolate, exerted from involucre, abaxially glabrous and not arachnoid-tomentulose, usually 4-nerved and 3-denticulate. **Disk florets** 25–55, bisexual, corolla gradually funnelform, 5-lobed, orangish-yellow or reddish-orange, hirsute near tube-throat juncture, tube elongate, lobes glabrous or with a single distal gland, anther thecae pale, base obtuse, ecaudate, endothelial tissue polarized, apical appendage ovate to oblong, slightly longer than wide; pollen tricolporate, echinate, tectum finely microporate, columellate layer well-defined (Robinson & Marticorena 1986), style base very slightly dilated, glabrous, trunk slightly papillose distally,

branches elongate and nearly filiform, 3–4 mm long, narrowing distally, abaxial surface rough-papillose, adaxially with continuous stigmatic surface. *Cypselae* prismatic to obovoid, thickly 10-costate (merely striate when immature), costae often tan and setose with nearly appressed trichomes, furrows usually brown and glabrous, cells walls with elongate raphids (Robinson 1983), pappus distinctly or indistinctly 2-seriate, mostly with an inner series of 15–30 elongate stramineous scabrid capillary bristles, several mid-sized outer squamellae typically present, these sometimes absent adaxially and represented instead by small outer bristles  $x = 12$ . Two species found in Andean Peru and Bolivia.

*Pseudonosotis* is a central Andean genus (Fig. 3) of two species that Robinson (1983) treated within Liabeae subtribe Paraneopheliinae. *Pseudonosotis* is diagnosed by its subscapose habit, milky latex, discolorous pinnately-veined sessile leaves, indumentum of long-stipitate-glandular trichomes on the scape, peduncles, and phyllaries, erect alternate-branched capitulescences, brightly colored ray corollas with limbs abaxially glabrous and not arachnoid-tomentulose, pale anthers, and filiform style branches. Color photographs of each species in the field were provided by Soejima et al. (2008). The two species of *Pseudonosotis* were each once treated within sometimes stipitate-glandular, brightly colored, and large-capitulate *Onoseris* (Mutisieae), which differs most conspicuously by outer florets with bilabiate corollas, tailed anthers, and short-ovate style branches.

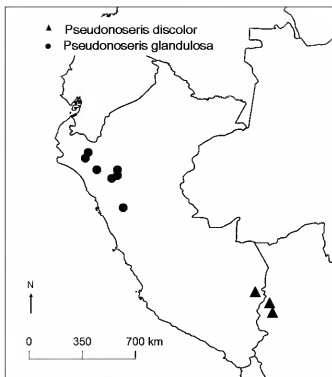


Figure 3. Distribution of *Pseudonosotis discolor* (Muschl.) H. Rob. & Brettell and *Pseudonosotis glandulosa* (Hieron.) Pruski in Andean Peru and Bolivia.



Figure 4. Photographs of the destroyed Berlin holotypes of the two recognized species of *Pseudonoseros*: A *Onoseris discolor* Muschl. [= *Pseudonoseros discolor* (Muschl.) H. Rob. & Brettell]; B *Onoseris glandulosa* Hieron. [= *Pseudonoseros glandulosa* (Hieron.) Pruski]

Although in the Soejima et al. (2008) study the relationships between *Pseudonoseros glandulosa* (as '*Pseudonoseros szyszlowiczii*') and *Paranephras* are unresolved, *Pseudonoseros* is maintained here as diagnosed morphologically by Robinson (1983). *Pseudonoseros* differs from *Paranephras* most obviously by some stipitate-glandular (vs. eglandular) indumentum, erect branched (vs. usually sessile) capitulescences, and by abaxially glabrous (vs. arachnoid-tomentulose) ray corolla limbs. Cytologically, the base number of *Labiace* appears to be  $x = 9$ , *Paranephras* was reported as  $x = 9$  and  $x = 14$ , and *Pseudonoseros* has been counted only once, being given as  $x = 12$  (Dillon & Turner 1982; Robinson et al. 1985).

**Typification and etymology.** The genus, name for its resemblance to *Onoseris*, is typified by *Liabum stratum*, the holotype of which is extant. The holotypes (Fig. 4) of our two species were destroyed, but neither species circumscription is in doubt. Thus, there is no pressing need taxonomically to lectotypify or neotypify either species name, and I am content to wait for possible holotype fragments or isotypes to be found. The descriptive basionym epithet *discolor*,



*glandulosum*, and *striatum* refer to the salient characters of *Pseudonosotis* of discolorous leaves, the distal stipitate-glandular indumentum, and the striate-costate cypselae, respectively.

1. Leaves simple, never lyrate-pinnatifid, adaxial surface rugose to rugulose; ray corollas orange or sometimes orangish-yellow; cypselae with pappus indistinctly biseriate. .... *Pseudonosotis discolor*  
 1. Leaves lyrate-pinnatifid, adaxial surface smooth; ray corollas scarlet or reddish-orange; at least some cypselae with an obviously biseriate pappus adaxially. .... *Pseudonosotis glandulosa*

**PSEUDONOSOTIS DISCOLOR** (Muschl.) H. Rob. & Brettell, *Phytologia* 28: 60. 1974. *Onoseris discolor* Muschl., *Bot. Jahrb. Syst.* 50, Beibl. 111: 94. 1913. *Liabum lanatum* Ferreyra, *Bol. Soc. Peruana Bot.* 1: 17. 1948 (non *Liabum discolor* (Hook. & Arn.) Benth. & Hook. f. ex Hemsl.). **TYPE:** PERU. Puno. Inter Sandia et Cuyocuyo, 2600–2800 m, 1 May 1902, *Weberbauer 883* (holotype: B<sup>+</sup>, photograph in F, MO, Macbride neg. 15889). Figs. 1, 2A, 4A.

**Rosulate or less commonly leafy-stemmed herbs** 10–70 cm tall; stems arachnoid-pubescent, also moderately dense long-stipitate-glandular (trichomes to 1.8 mm long and sometimes longer than stem diam.) to near base, internodes not hirsute and without simple patent trichomes, all leaves basal or proximal-cauline, when cauline with leaves paired with internodes 1–4 cm long but always much shorter than the leaves. Leaves 4–24 × 1–6 cm, lanceolate to oblong, broadest at mid-blade or slightly above mid-blade, simple, never lyrate-pinnatifid, adaxial surface rugose to rugulose, usually lingering arachnoid-pubescent especially along midrib and secondary veins, sometimes glabrate, broad-based or more commonly base narrowly acute, margins unequally sinuous-dentate to less commonly crenate or subentire, apex acute to sometimes obtuse. **Capitulescence** 1–2 per plant, held 9–50 cm above leaves, loosely cymose, 2–7-capitulate, branched in distal half; peduncles usually 2–10 cm long, moderately dense long-stipitate-glandular, sometimes with 2–3 linear bracteoles 1–3 mm long. **Capitula** 14–16(–18) mm long (excluding rays); involucre 10–13 × 8–18 mm; phyllaries 3–13 × 1–2 mm, with a purplish mid-zone and scarious margins. **Ray florets** 12–26; corolla orange or sometimes orangish-yellow, tube 10–13 mm long, limb 20–24 × 2.5–3 mm. **Disk florets:** corolla 11–13 mm long, orangish-yellow, lobes 2–3 mm long. **Cypselae** 2–3.2 mm long; pappus indistinctly biseriate, inner pappus bristles 15–25, 8–10 mm long, outer pappus bristles few, 0.1–0.3 mm long, not obviously much broader than inner series of bristles.

**Representative exsiccatae examined.** **BOLIVIA.** La Paz. Franz Tamayo, Parque Nacional Madidi, Kearsa–Moxos, Kelluturo, 3000 m, 13 May 2008, *Arayo 4143* (BM, LPB, MO), *Arayo 4194* (B, GH, LPB, MO); Franz Tamayo, ANMI Apolobamba, sector Laitiki hacia Piara, entre Pelehuco y Apolo, 2650 m, 20 Apr 2006, *Fuentes et al. 10422* (LBP, MO, NY). **PERU.** Puno. Sandia, Limbani, 3300 m, 7 Jun 1974, *Chávez 2382* (MO); Sandia, dry open hillside near Limbani, 3200–3450 m, 14–16 May 1942, *Metcalf 30531* (MO, UC).

**Distribution and ecology.** *Pseudonosotis discolor* occurs in puna from 2600–3450 meters elevation, north of Lake Titicaca in the Andes of Puno, Peru, and adjacent La Paz, Bolivia (Fig. 3). The species is saxicolous and flowers from April to June.

**Illustrations of *Pseudonosotis discolor*** were provided by Ferreyra (1948) and Robinson (1983). *Pseudonosotis discolor* was given by Robinson and Brettell (1974), Robinson (1983), Beltrán et al. (2006), and Soejima et al. (2008) as endemic to Peru, but this species is now known from several collections in adjacent Bolivia. The protologue described it as similar to *Onoseris glandulosa* [= *P. glandulosa*]. The few inner pappus bristles and the indistinctly biseriate pappus are distinctive features of *P. discolor*. Some color photographs of *P. discolor* appear to show the ray corollas as orangish-yellow, but the plants are usually described as orange-flowered.

**PSEUDONOSERIS GLANDULOSA** (Hieron.) Pruski, comb. nov. *Onoseris glandulosa* Hieron., Bot. Jahrb. Syst. 21: 366. 1895. TYPE: PERU. **Cajamarca**. Prope La Cruz de Celendin, inter Pacasmayo et Moyobamba, 3100 m, Apr–Jun 1868–1877, *Stübel 35h* (holotype: B†, photograph in F, MO, Macbride neg. 15890). Figs. 2B, 4B, 5.

*Liabum szyszyłowiczii* Hieron., Bot. Jahrb. Syst. 36: 503. 1905. *Pseudonosotis szyszyłowiczii* (Hieron.) H. Rob. & Brettell, Phytologia 28: 60. 1974. TYPE: PERU. **Cajamarca**. Prope Callacate, May 1879, *Jelski 718* (holotype: B†, photograph in F, MO, Macbride neg. 18133).

*Liabum striatum* Cuatrec., Collect. Bot. (Barcelona) 3: 306. 1953. *Pseudonosotis striata* (Cuatrec.) H. Rob. & Brettell, Phytologia 28: 60. 1974. TYPE: PERU. [presumably near the **Lambayeque-Piura** border near Abra de Porculla]. Above Olmos, 1800–1900 m, May 1915, *Weberbauer 7107* (holotype: F, photograph in MO, Field neg. 49222).

**Rosulate or leafy-stemmed herbs** 20–90 cm tall; stems arachnoid-pubescent, also long-stipitate-glandular (trichomes to 1 mm long and sometimes longer than stem diam.) distally, grading to hirsute with simple patent trichomes proximally, all leaves basal or proximal-cauline, when cauline then in cauline-rosettes or with leaves paired with internodes 1–5 cm long but always much shorter than the leaves. Leaves 6–18 × 2.5–10 cm, lyrate-pinnatifid with terminal lobe the largest and usually with 2–3 pairs of lateral lobes, oblong to obovate in outline, adaxial surface smooth, hirsutulous to subtrigillose with patent or subappressed trichomes, also sometimes arachnoid-pubescent, broad-based or less commonly base attenuate, lobes nearly lateral, triangular-ovate with sinuous-denticulate margins, sinuses rounded, apex obtuse to sometimes acute. **Capitulescence** 1–2(–3) per plant, usually held 15–30 cm above leaves, loosely cymose, usually 2–9-capitulate, branched only in distal half; peduncles usually 2–15 cm long, more densely pubescent than stem and proximal capitulescence axis. **Capitula** 12–19 mm long (excluding rays); involucre 10–15 × 10–20 mm; phyllaries 3–15 × 1–2 mm, linear-lanceolate, appearing 2-costate at least near mid-phyllary. **Ray florets** 13–21; corolla scarlet or reddish-orange, tube 10–11 mm long, limb 15–20 × 2–3 mm. **Disk florets**: corolla 9–12 mm long, reddish-orange, lobes 2–2.5 mm long. **Cypselae** 2–4 mm long; with pappus obviously (at least adaxially on some cypselae) biseriate, inner pappus bristles 25–30, 6–8 mm long, outer squamellae 0.5–1.5 mm long, at least the adaxial ones on some cypselae noticeably broad-based and obscuring inner bristle bases, the abaxial ones especially of the ray florets sometimes represented by very small bristles.  $2n = 24$  (Dillon & Turner 1982).

**Representative exsiccatae examined.** PERU. **Amazonas**. Chachapoyas, encima de 'Leimebamba', 2600–2700 m, 16 Apr 1964, *Ferreira 15465* (MO, USM); 6 kms along road W of Chachapoyas, 6600 ft, 13 Jan 1983, *King & Bishop 9198* (MO, US); 15 km from Chachapoyas towards Mendoza, 2200 m, 13 Mar 1998, *van der Werff et al. 14833* (MO, US); 1 km SW of Chachapoyas, 2300 m, 22 May 1962, *Wurdack 467* (MO-2, US); Chachapoyas, km 422–417 on 'Leymebamba'–Balsas road, 2400–2700 m, 21 Feb 1984, *Smith 6077* (MO). **Ancash**. Huari, 2500 m, 2 May 1962, *Ames 7* (MO). **Cajamarca**. Jelij, grassland, 3035 m, 16 June 2009, *Bussmann et al. 15526* (MO, NY); Jaén, Sallique, de Catala a Piquijaca, 1940–2195 m, 29 Jul 1998, *Campos & Díaz 5396* (MO, US); Carretera entre Súcota y Cutervo, 2000–2200 m, 20 Apr 1988, *Díaz & Baldeón 2844* (F, MO); 26 km NW [on maps this appears instead to be NE] of Celendin on road to Balsas, 2300 m, 5 Jan 1979, *Dillon & Turner 1699* (F, MO, US); Yamaluc, entre Cochabamba y Huambos, 2300–2500 [annotated in pencil as 1900–2000] m, 1 Aug 1946 (post fruit), *Ferreira 828* (MO); Km 156 de la carretera Pacasmayo–Cajamarca, 2650 m, 5 Apr 1982, *Sánchez-Vega 2758* (MO); Chachapoyas–Celendin road, above Celendin, 3000 m, 28 May 1984, *Smith & Cabanillas 7303* (MO). **Lambayeque**. The type of synonymous *Liabum striatum*, presumably near the Lambayeque-Piura border near Abra de Porculla. **Piura**. Huancabamba, Porculla, 2200 m, 10 May 1992, *Llatas & Cruz 3106* (F, MO).



Figure 5. Representative specimen of *Pseudonoseris glandulosa* (Hieron.) Pruski. (Smith & Cabanillas 7303, MO).

Distribution and ecology. *Pseudonosotis glandulosa* is endemic to Andean Peru in and south of the Huancabamba Depression, where it occurs in both cordilleras, these separated by the Río Marañón (Fig. 3). *Pseudonosotis glandulosa* occurs mostly in the montane zone and in *jalca* formations (sometimes it is saxicolous) from 1800–3400 meters elevation in the Departments of Amazonas, Ancash, Cajamarca, Lambayeque, [expected in La Libertad], and Piura and flowers from January to July. Although *P. glandulosa* presumably did not migrate across Huancabamba Depression during Pleistocene climatic oscillations, it is moderately successful ecologically as it occurs on the cordilleras both west and east of Río Marañón valley. *Dorobaea laciniata* B. Nord. & Pruski and *Talamancaia putcalensis* (Hieron.) B. Nord. & Pruski (Nordenstam & Pruski 1995; Beltrán & Pruski 2000) are other regional subcapose lobe-leaved large-capitulate orange-flowered taxa (both are Senecioneae) resembling superficially *P. glandulosa*.

The protologue noted specifically that this taxon lacked the inner corolla lips typical of *Onoseris* (Mutisieae). *Pseudonosotis glandulosa* was excluded from *Onoseris* by Ferreyra (1944), who referred provisionally this species to *Liabum*. *Pseudonosotis glandulosa* was not treated subsequently in the Mutisieae in the Flora of Peru (Ferreyra 1995) nor elsewhere in the Mutisieae (Katinas et al. 2008). By opposite leaves, radiate capitula, moderately long-lobed disk corollas, ecaudate anthers, style trunks distally papillose, and style branches with continuous stigmatic surfaces, *P. glandulosa* keys to tribe Liabeae in Pruski and Sancho (2004), where it matches *Pseudonosotis* by its subcapose habit, indumentum of some long-stipitate-glandular trichomes, erect alternate-branched capitulescences, brightly colored ray corollas, pale anthers, and filiform style branches. Soejima et al. (2008) gave this species as having arisen through hybridization between *Pseudonosotis* and *Paranephelus*. Cytologically, *P. glandulosa* was reported by Dillon and Turner (1982) as  $2n = 24$ , the only count published for the genus.

No significant consistent morphological differences are found between plants of (1) the Pacific slopes of the Cordillera Occidental –the coastal range– (e.g., the presumed type locality of *P. striata*), (2) those of the interior slopes Cordillera Occidental just west of the Río Marañón (generally between 6° and 7° S latitude) of Depto. Cajamarca (e.g., the types of *P. glandulosa* and *P. szyszlowiczii*), (3) those east of the Río Marañón in the Cordillera Oriental in Depto. Amazonas near Chachapoyas, or (4) with those much further south in Depto. Ancash. Weigend (2002) noted that although species are often restricted distributionally to one side of the Andes, this generalization may break down in the upper Río Marañón valley where several groups are found in the coastal as well as interior mountains. Although plants of *P. glandulosa* from the Cordillera Occidental on average tend to have a more obviously biseriolate pappus than, for example, do plants of the Cordillera Oriental from near Chachapoyas, this pappus variation is never as great as that found within some individual florets and within some individual capitula. Accordingly, both *P. striata* and *P. szyszlowiczii* are treated in synonymy of *P. glandulosa*, lowering from three to two the number of species recognized in *Pseudonosotis*.

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**JUSTICIA BRANDEGEEANA (ACANTHACEAE):  
NEW TO THE TEXAS FLORA**

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**ABSTRACT**

*Justicia brandegeana* is documented as occurring outside of cultivation in Texas. Several colonies were found growing on a terrace above Coletto Creek in Victoria County. It is suspected that seeds were dispersed from landscape plantings in the Victoria area. *Justicia brandegeana* has moderate invasive potential along the Texas coast.

**KEY WORDS:** Acanthaceae, *Justicia*, Texas, naturalized

*Justicia brandegeana* Wash. & L.B. Sm. (Acanthaceae), commonly known as shrimpplant or Mexican shrimpplant, was recently documented as naturalizing in Victoria County, Texas. The species has not been previously reported outside of cultivation in Texas (Correll & Johnston 1970; Hatch et al. 1990; Jones et al. 1997; Turner et al. 2003). The species has escaped cultivation and is naturalized in peninsular Florida, where it is reported in eight counties (USDA, NRCS 2012; Wunderlin & Hansen 2012). In Texas, *J. brandegeana* has been reported to naturalize in some places on the Texas coastal plain (Kress 2007) but without herbarium specimen evidence.

*Justicia brandegeana* is an evergreen perennial shrub native to Mexico and a common ornamental that thrives in the shade in tropical areas (FLORIDATA 2012). The species is named after Townsend Stith Brandegee (1843–1925), botanist and expert on the Cape flora of Baja California. The flowers are white, protruding from rusty-reddish bracts that generally suggest a shrimp, hence the common name. A number of cultivars are available with yellow, pink, and dark brick-red flower bracts. The flower-bract complex attracts hummingbirds and butterflies.

*Justicia brandegeana* (Figs. 1, 2) was discovered in a coastal live oak (*Quercus virginiana*) motte on a creek terrace in Victoria County. The dominant flora included *Quercus virginiana*, *Ilex vomitoria*, *Vaccinium arboreum*, *Callicarpa americana*, *Erythrina herbacea*, *Malvaviscus drummondii*, *Smilax bona-nox*, *Tillandsia recurvata*, *Sideroxylon lanuginosa*, *Cenchrus incertus*, *Toxicodendron radicans*, *Heterotheca subaxillaris*, *Froelichia* sp., *Cyperus* sp., and *Dichanthelium* sp. It is suspected that shrimpplant seeds were dispersed from landscape plantings, possibly by birds, in the Victoria, Texas, area. Numerous colonies (averaging 1 x 1 meters) were present in a slightly over one hectare (three acres) site, with some colonies spreading to 3 x 3 meters. These colonies are reproducing vegetatively through rhizomes and adventitious roots on branches near the ground.





Figure 1. Habit of *Justicia brandegeana* in Victoria County, Texas (Singhurst 19318, BAYLU).



Figure 2. *Justicia brandegeana* inflorescence and flower (Singhurst 19318, BAYLU).



Voucher specimen. USA. Texas. Victoria Co.: 1.7 mi S of the jet of Dawn Road and Coletto Creek Park Road on Coletto Creek Park Road, to N side of Coletto Creek spillway below dam, then E of dam 0.4 mi, 4 Dec 2012, *Singhurst 19318* (BAYLU).

*Justicia brandegeana* (Figs. 1, 2) grows in clumps to 1–1.5 meters (3–5 ft) tall and 1 meters (3 ft) wide that occasionally may spread or converge to form larger colonies. The stems are sprawling, weak, and slender. Stems are tipped by drooping spikes about 15 cm long of dark red to rusty brown bracts, each bract enclosing a tongue-like white flower. Shrimpplant is evergreen in mild climates and blooms almost continuously. The leaves are oval, light green, and 5–8 cm long. The young stems and the undersides of the leaves are soft and downy.

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